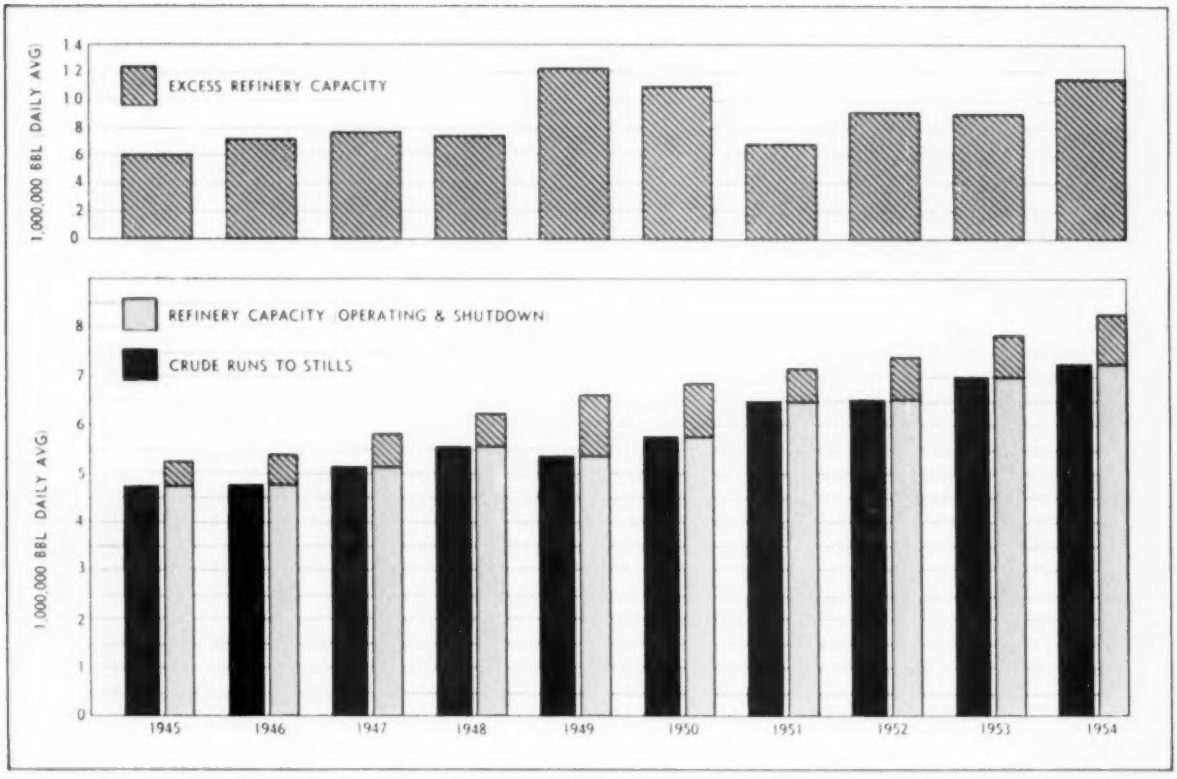
PETROLEUM PROCESSING

including Petrochemical Processing Section

DECEMBER 1953



The Picture for '54—Excess refining capacity still rising—p. 1863

You Can Profit by Corrosion

Use your experience data file for help in corrosion prevention work — p. 1866

What's Unique About Tuscola?

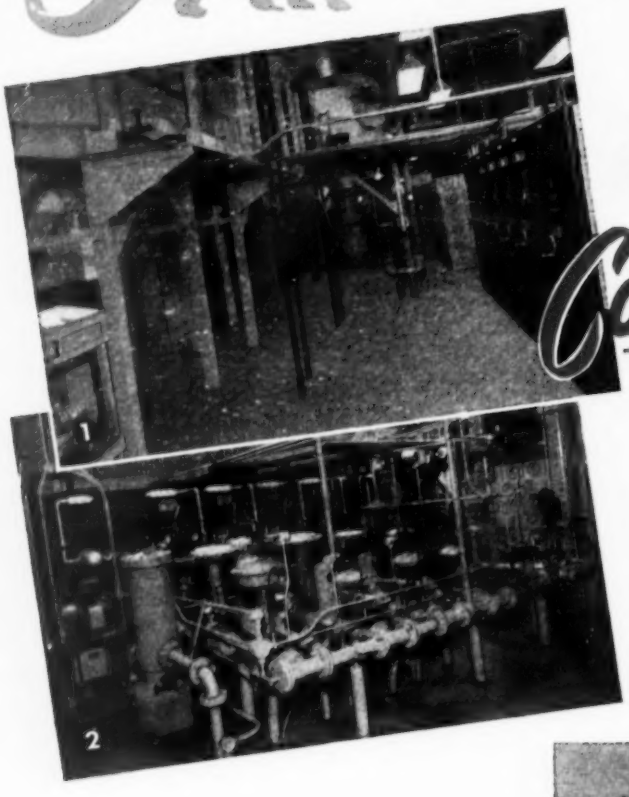
Three articles on the plant, its people, and its start-up — p. 1889

A McGRAW-HILL PUBLICATION

SINCLAIR *INCREASES OUTPUT...*

...with % PROPORTIONEERS %

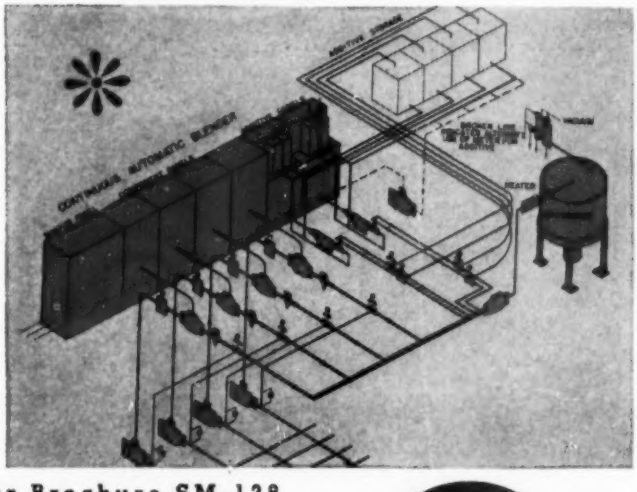
Automatic Compounding



This new %Proportioneers% installation at the Marcus Hook plant of Sinclair Refining Company utilizes phase control between components of lube stocks to reduce batch blending to completely automatic compounding. %Proportioneers% recirculation method permits exact presetting and control of component and additive ratios and allows quick adjustment of the total rate to production requirements without affecting these ratios. %Proportioneers% Continuous, Automatic Compounding makes possible greater flexibility between small and large quantity production with increased operating efficiency and new economies in material handling.

❶ %Proportioneers% compounding panels at right, additive storage upper left, and flash evaporator in background.

❷ Back side of compounding panels showing control valves, recirculation system, and blend manifold.



✳ **All equipment shown** red **in flowgram furnished by %Proportioneers, Inc.%**

For complete information ask for Brochure SM-138

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447 HARRIS AVE., PROVIDENCE 1, RHODE ISLAND

Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries. Consult your telephone directory or write to %Proportioneers, Inc.%

Why we took a Jaguar to Detroit

Records of speed and endurance races won show that under the flowing lines of the Jaguar automobile is an unusually fine engine . . . an engine we were more than ordinarily curious about.

You see, we had heard reports that despite this engine's high power output, its octane requirements were quite modest. And to our way of thinking, anything that might stimulate the building of more mechanical octanes into engines is a step in the right direction.

So we brought a Jaguar engine to our Detroit Research Laboratories and put it through a series of tests. The reports were true. It did have a relatively low octane requirement. And we felt pretty sure our friends in the engineering departments of the automobile manufacturers would be interested in our findings.

(Continued on next page)

ETHYL
ETHYL CORPORATION

Printed in U. S. A.

Why we took a Jaguar to Detroit

(Continued from preceding page)

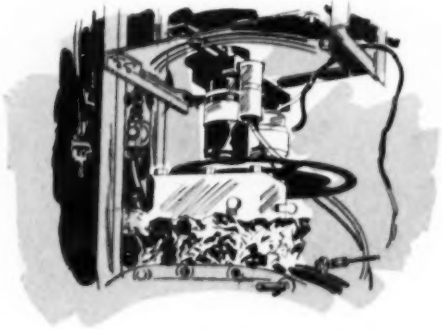
We took the Jaguar engine down, and exhibited the parts at special meetings for automotive people. Of course, American manufacturers producing cars in tremendous volume face entirely different problems from those of a maker of a limited-edition sports car. But judging from the interest and discussion, these meetings were a tremendous success.

These Jaguar meetings are just an example of Ethyl's work to make the most efficient use of every octane produced by the petroleum industry. We believe they illustrate an interesting point: because of its unique position in the oil industry, Ethyl is able to work for the industry and be of material assistance in the all-important job of fitting engines to fuels and fuels to engines.

And in the last analysis, cooperation between the automotive and petroleum industries is the key to future progress in motor transportation.

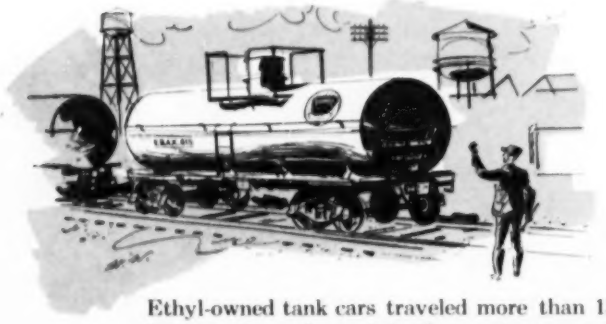
ETHYL CORPORATION
NEW YORK 17, NEW YORK

WORTH NOTING



A radiation pyrometer—a special temperature measuring device—has been adapted by the Ethyl Research Laboratories . . . to aid in the study of engine hot spots.

George Washington won freedom for our country with only 17,000 soldiers. If all the people who have seen Ethyl's dealer-education show "The Product Sales Clinic" were gathered together, they would equal six Continental Armies!



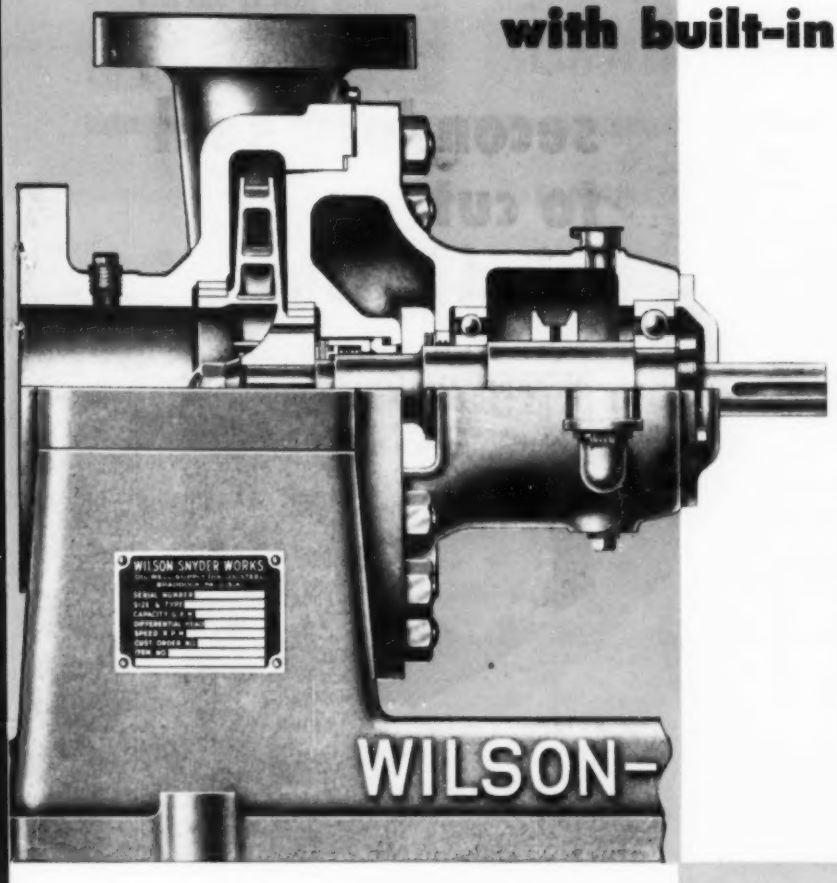
Ethyl-owned tank cars traveled more than 13 million miles last year to make certain that customers received "Ethyl" antiknock compound when and where they needed it!

Ethyl Service is backed by 30 years of antiknock experience

an addition to the line of Wilson-Snyder Pumps!

Type ESC PROCESS CENTRIFUGALS

with built-in mechanical seal



9 sizes

from

- *15 to 1200 GPM Capacity*
- *40 to 470 Feet Head*
- *Subzero to 250° Fahrenheit*
- *15 to 750 p.s.i. Discharge*
- *2 to 100 Horsepower*

Type ESC horizontal, single-stage centerline supported centrifugal pumps with vertically-split case are heavy-duty pumps specifically designed for a mechanical seal. They have a spacer-type coupling and sloping-top drain base plate. At minimum cost, they provide rugged, dependable, and fool-proof construction for continuous and efficient operation.

1. Built-in balanced mechanical seal eliminates gland, packing, sleeve, and set screws. Only one seal size is used for all pump sizes.

2. Short overhang of impeller reduces shaft deflection, vibration, and length of pump.

3. Large streamlined impeller eye results in low NPSH requirements.

4. Parts are highly interchangeable between all sizes, minimizing inventory.

5. Wearing parts can be replaced without disturbing case, piping, or driver.

6. Extra strong case and bearing bracket design assure true alignment and smooth operation.

7. Wear rings on both sides of impeller minimize thrust and stuffing box pressure.

FOR FULL INFORMATION . . . or quotations on Wilson-Snyder Process Pumps, contact "Oilwell's" Refinery Specialist at Area Office points shown below, or Wilson-Snyder Works, Braddock, Pennsylvania

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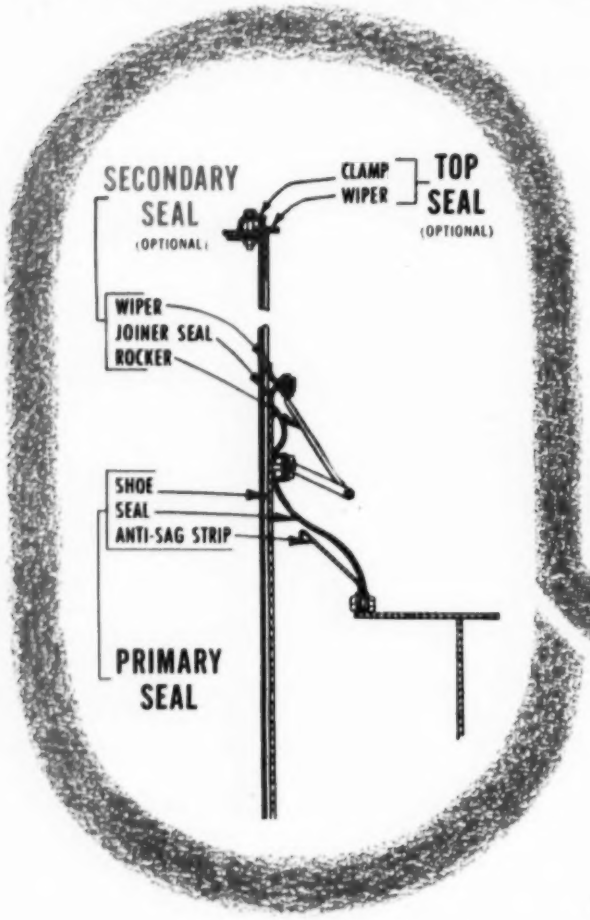
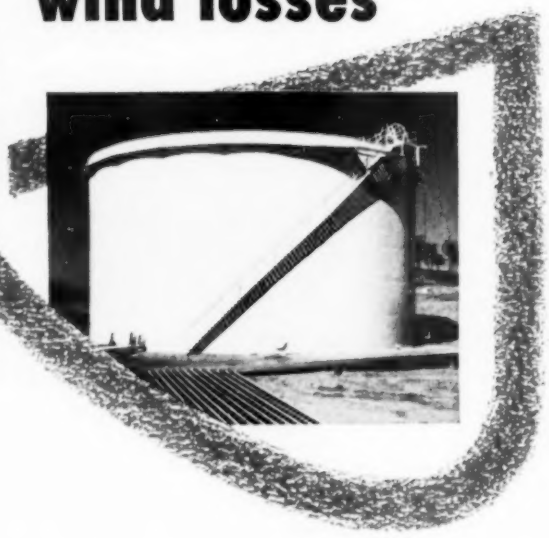
the important factors in **floating roof design**

number 4 of a series



secondary seal to cut wind losses



Air currents cause a pulsating action above the primary seal which can draw vapor out of the area where the seal shoe contacts the shell.

Wiggins Floating Roofs have a Secondary Seal, a synthetic rubber coated fabric sealing ring riding against the tank shell above the primary seal. This patented Wiggins feature reduces wind action so effectively that it has been known to eliminate 50% of the evaporation losses suffered by tanks having only a single seal.

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PETROLEUM PROCESSING

Covering petroleum and petrochemical research and the design, construction, management, operation and maintenance of plants processing hydrocarbon materials into fuels lubricants and chemicals.

December, 1953
Vol. 8, No. 12

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330 West 42nd St., New York 36, N. Y.

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IS LIQUID CARRY OVER–

. . . Limiting Your Production?
. . . Affecting Product Purity?
. . . Cutting Into Your Profits?

IF SO–GET THE FACTS ON METEX MIST ELIMINATORS!

Section of a METEX MIST ELIMINATOR, opened to show construction. They can be made of practically any metal, to combat corrosion. Factory cut to fit vessel dimensions and contour, there is no limit to the size in which they can be obtained.

Liquid entrainment need no longer be considered an unavoidable nuisance in processing operations, as more and more engineers are finding from experience. These *knitted* wire mesh entrainment separators literally "filter out" the entrainment (see diagram) and permit the gas to pass on, freed from the unwanted–and often contaminating–liquid.

METEX MIST ELIMINATORS can be easily installed in new or existing vessels. They require no special housings, equipment or power–and need no servicing or attention. They function over a wide range of velocities with a pressure drop usually so low it cannot be measured. Users report efficiencies of 99% and more.

METEX Mist Eliminators can be used wherever the problem of liquid entrainment exists. By effecting complete removal of liquids, Mist Eliminators contribute to more efficient and economical processing in such vessels as:

- **VACUUM PIPE STILLS**
- **FRACTIONATING TOWERS**
- **KNOCK-OUT DRUMS**
- **EVAPORATORS**
- **ABSORBERS**
- **SCRUBBERS**
- **COMPRESSORS**
- **SEPARATORS**
- **STEAM DRUMS**

Write TODAY for free catalog giving complete information and engineering data. Or tell us about your SPECIFIC entrainment problem.

When a gas is generated in or passes through a liquid (1), it carries with it on leaving the surface (2), droplets of entrained liquid. These droplets are carried upward by the rising gas stream (3). As the gas continually changes direction in passing through the pad, the droplets are impinged on the extensive wire surface. Here the droplets coalesce, forming large drops of liquid which break away (4) from the pad and fall back through the gas stream. The gas (5) passes on, freed from liquid entrainment.

METAL TEXTILE CORPORATION

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METEX

Roselle, New Jersey

CATALYST CONTAMINATION CURED BY REMOVING ENTRAINMENT IN DISTILLATION UNIT

Equipment Costing $15,000 Pays Out In Under A Week For Large Southwestern Refinery

It was not a difficult problem to trace the cause of mounting catalyst losses to a cat unit feed so poor in color that it was essentially black. Entrainment of liquid from the bottom of the still column could be the only answer.

Here was a situation where a Metex Mist Eliminator would remove the entrainment – but what else might happen? Would this knitted wire mesh separator cause excessive pressure drop? How quickly would it become plugged by coke deposits and make the column inoperable?

Calculations by one engineer showed that the total cost of installing a 25-ft diameter Mist Eliminator, including designing and erecting supports within the still, was approximately $15,000 – less than a week's catalyst loss. After considerable study the decision was made, and the Mist Eliminator installed during the next routine turnaround.

When the first run of cat unit feed came from the remodeled crude distillation unit, it was crystal clear and water white. Throughout the normal run no differential pressure across the screen was found.

The problem was solved. Catalyst losses dropped sharply. And the Mist Eliminator has paid for itself in a matter of days.

Have you really analyzed your entrainment costs, and checked the savings a Mist Eliminator could make for you? Perhaps you are losing valuable end products in the exhaust stream. Perhaps you have a nuisance contamination problem. Perhaps the entrainment created in one vessel is causing trouble in a subsequent operation. For entrainment is an inevitable result of most processing and refining operations.

Metex Mist Eliminators perform just one function–and they are doing it in more and more refining vessels every day. They remove liquid entrainment–efficiently and economically–wherever it may occur.

Why not write today for more information on Metex Mist Eliminators. Or better yet, send data on your particular entrainment problem. We'll be glad to have our engineers check this, and send you our recommendations and suggestions.

PETROLEUM PROCESSING

Publisher's Page

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Editorial & Business Offices
330 West 42nd St., New York 36, N.Y.

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We've Moved Our Editorial and Business Offices

AFTER 44 years of having our editorial offices in Cleveland, we've moved them. By the time you read this issue of PETROLEUM PROCESSING, we should be completely relocated and well settled on the 25th floor at 330 West 42nd Street in New York City.

By the way, for whatever interest it might be to you and posterity, these few paragraphs have the doubtful privilege of being the first editorial product from our new domain. If they seem disjointed, I'm sure you'd understand it if you could but see the conditions under which they are being written—cartons stacked all over the place, telephones ringing incessantly, mechanics assembling equipment and attaching typewriters, and just plain people milling around.

The move was planned for the Thanksgiving weekend, and arrangements were begun about two months in advance. The editorial offices of PETROLEUM PROCESSING were scheduled to be packed on the Wednesday before Thanksgiving, the other offices on the Friday following. The movers were scheduled to load the vans in Cleveland Friday evening, unload them in New York Sunday morning, get everything in its proper position, and have us back in business at 9 am Monday morning, Nov. 30th. They did it!

Well in advance of the move we rejuggled our printing schedule for the December issue (which normally would have been going to press right plunk in the middle of the move), so that we would have nearly everything out of the way before the move. Every person on the staff was assigned a specific position and file number in the New York office, and was responsible for seeing that all the material for his position and files was properly tagged.

One thing that complicated matters was the fact that not everything was going to the 25th floor. Some material was going to storage, some to other departments in the company (on different floors), and some even to other buildings. Each destination was given an identifying color or label to be used on its packages, and it turned out that our colors were green and yellow.

We put up quite a howl about them at first, and agreed to use them only after we were assured no personal reflections were intended, and that those were the only colors of labels of which they had enough to handle all our packages.

If you are ever in New York City and in the vicinity of the McGraw-Hill Building on 42nd Street, drop up to the 25th floor and see us. We'd be glad to show you around our new home.

William J. Bland

For the editors

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What's Happening...

in Refinery Expansion

. . . **Pressure is off for new alkylation facilities,** with 22,000 b/d alkylate capacity expansion now in sight, according to Deputy Petroleum Administrator Joseph La Fortune.

Expansion goal of 30,000 b/d is being retained and PAD will continue to recommend rapid tax write-offs for new projects, but emphasis will definitely relax, La Fortune said.

. . . **Berry Asphalt Co.** has completed negotiations for a long-term lease of a 7,000 b/d refinery at Gary, Ind., formerly owned and operated by Johnson's, Inc. New equipment will be added for asphalt manufacture. Berry expects to produce full line of asphalt products for both highway and industrial uses, specializing in rubber/asphalt products.

. . . **Anderson-Prichard Oil Corp.** has awarded a contract for an Atlantic Refining Co. Catformer at its Cyril, Okla., refinery, with completion scheduled for early in 1954. Blaw-Knox Co., Chemical Plants Div., has contract, with engineering, procurement, and construction being handled by Blaw-Knox western headquarters at Tulsa, Okla. Capacity of unit was not revealed.

. . . **McBride Oil & Gas Corp.,** newly formed, will soon launch a $5,000,000 program of plant expansion, reorganization and oil & gas development. The 7500 b/d Port Fuel Oil Co. plant at Port Brownsville, Texas, will be upped initially to 10 to 15,000 b/d and ultimately to 20,000 b/d, by installing new topping facilities, probably catalytic reforming and other undetermined units, at an estimated $2,500,000. New company will take over McBride Refining Co., Inc., with its 2000 b/d refinery at La Blanca, Texas, in addition to Port Fuel Oil Co., and several other properties.

. . . **Signal Oil & Gas Co.** has completed arrangements to build and operate a natural gasoline plant in Fox-Milroy area of Ardmore Basin, Carter County, Okla. Plant is being designed to process 40 million cf/d with a capacity of 100,000 gal. of LPG and natural gasoline.

. . . **Pennzoil Co.** will build a new 12,000 b/d combination atmospheric and vacuum crude distillation unit at Rouseville, Pa., replacing three smaller stills that have been in operation many years. M. W. Kellogg Co. has contract.

. . . **Standard Oil Co. (Indiana)** has announced the availability of its new fixed-bed catalytic reforming process, Ultraforming, under licensing arrangements. Process uses a platinum-containing catalyst to be supplied by American Cyanamid Co. Three Ultraforming units are now being built: Pan-American Refining Corp., Texas City, 21,200 b/d; Pan-Am Southern Corp., El Dorado, Ark., 6800 b/d; and Standard of Indiana, Wood River, Ill., 9000 b/d.

. . . **First National Petroleum Corp.** has purchased, for "somewhat less" than $250,000, a refinery at Jensen, Utah, owned by Utah Co-operative Assn., and plans to expand facilities to double existing capacity of 1500 b/d. A $1,250,000 cracking unit also will be built.

. . . **Carter Oil Co.** has awarded contract for its new 3800 b/d fluid coking unit at Billings, Mont., to the Fluor Corp. New unit, first commercial installation of its kind, is first step in an extensive refinery expansion at Billings, and is scheduled for completion by October, 1954.

. . . **Standard Oil Co. (Ohio)** has awarded two contracts totaling $2,200,000 for engineering and construction at Lima and Cleveland No. 1 refineries. Lima project is for new tankage: Cleveland project is for equipment additions and revamping in catcracker gas plant, thermal gas plant, and cat poly plant.

. . . **Shell Oil of Canada** plans second expansion within two years of its Jumping Pound gas processing plant, 20 miles west of Calgary, Alta. Original capacity of 25 million cu. ft. daily will be increased to 70 million. Refinery Engineering Ltd. of Toronto has contract, and construction is scheduled at an early date.

. . . **Standard Oil Co. of British Columbia Ltd.** has awarded Fluor Corp. of Canada Ltd. contract for an SOD Model IV Fluid catalytic cracking unit, of 3750 b/d design feed capacity, at Vancouver, B. C. Complete project including related facilities is scheduled for completion in October, 1954.

. . . **Royalite Products Ltd.** is building a new refinery at Kamloops, B. C., for an estimated $6,000,000, with Caribou Engineering Co. Ltd., Vancouver, as primary contractor. Crude unit, with capacity of 5000 b/d, is scheduled for completion early in February by Caribou. A 1410 b/d Fluid catalytic cracking unit, a cat poly unit, and gas concentration unit are to be completed early in 1955, all under agreement with Universal Oil Products Co.

. . . **Gulf Oil Co.** will expand capacity of its Puerto La Cruz, Venezuela, refinery from 50,000 to 75,000 b/d in project scheduled to start in January, at a cost of about $6,000,000.

. . . **New petroleum processing plant expansions** to look for, as indicated by rapid tax amortizations announced last month:

Gulf Refining Co., $5,787,000 for 10,000 b/d Platforming unit and auxiliaries at Toledo, Ohio.

Petrolite Corp., $38,518 for 16,000 b/d crude oil

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

desalting unit at Amarillo, Texas, refinery of The Texas Co.

Petrolite Corp., $47,918 for 33,000 b/d crude oil desalting unit at Mandan, N. Dak., refinery of Standard Oil Co. (Indiana).

The California Oil Co., $1,635,000 for revamp of catalytic cracking unit and increased butane storage at Perth Amboy, N. J.

The Texas Co., $293,600 for 85 b/d cat poly unit at Sunburst, Mont.

Woodlawn Processing Corp., $1,625,000 for natural gas extraction plant at Woodlawn Field, Harrison County, Tex.

The Texas Co., $11,653,100 for refining facilities at Lawrenceville, Ill., and Mt. Vernon, Ind.

in Petrochemicals

. . . **Monsanto Chemical Co.** will build its first polyethylene production plant at Texas City, Texas, adjacent to its existing facilities at that city. Contractor is Farnsworth and Chambers of Houston. Initial annual capacity will be about 66,000,000 lbs., with a 50% increase scheduled for 1957. Operations are expected to start in fourth quarter of 1954.

. . . **Brea Chemicals, Inc.,** a subsidiary of Union Oil Co. of California, will build a $750,000 dry ice plant near its ammonia plant now under construction in Los Angeles. Plant will use by-product carbon dioxide from the ammonia facilities.

. . . **Japan has long range plans for petrochemicals** production, especially for the manufacture of plastics, synthetic fibers, and detergents, according to UOP's Gustav Egloff on his return from a month's tour of that country. Although concentrating on revitalizing their refining industry, the Japanese are striving to install five basic plants to utilize crude oil for chemical purposes.

. . . **du Pont** has announced a $2,000,000 expansion program at two of its plants manufacturing "Freon" fluorinated hydrocarbon compounds—Deepwater Point, N. J., and East Chicago, Ind. Starting point of one of the processes to be used is methane derived from natural gas.

. . . **Petrocarbon Chemicals, Inc.,** will build a new 1000 b/d Houdriformer at its Irving plant, near Dallas, Texas. Unit is designed for wide flexibility for projected use in petrochemical service and high octane fuels. Tears Engineers will handle engineering and construction, with completion scheduled for mid-1954.

in Markets and Prices

. . . **Refined products generally were easy,** except for heavy fuels, in virtually all primary supply markets in November. Mild weather in most consuming areas east of the Rockies kept gasoline moving fairly well, but not enough to keep prices from slipping. And it forced further increases in already top-heavy inventories of heating oils.

. . . **First move toward lower wholesale gasoline prices** since the mid-June advance in crude oil postings got underway in the East, with Socony-Vacuum, Esso Standard, and Atlantic Refining cutting tank wagon postings an average of 0.25¢/gal in most seaboard states from Maine through the Carolinas.

At primary supply level, regular-grade gasoline, 87 octane, slipped another 0.125¢, to 11.5¢/gal, for cargo lots at the Gulf, and Group 3 prices for regular were down the same for cargo lots at the Gulf, and Group 3 prices for regular were down 0.125¢ to 11.25¢.

That refiners were anxious to whittle down gasoline inventories was evidenced in bids to the Armed Services Petroleum Purchasing Agency. The agency, in market for 4,500,000 bbl. of regular to meet its first-half-1952 requirements, was offered more than 15,000,000 bbl. And prices quoted for the deferred delivery period were as much as 0.8¢/gal lower than refiners quoted for nearby liftings.

. . . **Distillate fuel shipments** of some eastern refiners were as much as 48% below year-ago levels, with spring-like weather. In the Midwest, there was an embargo on all Great Lakes Pipe Line shipments because of a glut of Nos. 1 and 2 fuels in the system.

. . . **Residual fuel was bright spot** in the general market picture. Mid-Continent prices were up another 10¢/bbl., to $1.35; Group 3, and prices were firm to strong in all other districts.

Looking Ahead

. . . **"Tween the devil and deep blue?"**—or, "What do we do now?"—

The sudden surplus buildup on the West Coast has caught several West Coast majors in various stages of refinery expansion. Although PETROLEUM PROCESSING has heard misgivings expressed regarding the scale of some of the expansion projects, no cutbacks or cancellations have yet been reported.

One reaction is that companies may experience discomfort while their new capacity (with attendant costs) is running ahead of demand, but that eventually demand will overtake it. Immediate problem is that marketing departments have a lot of product to dispose of.

On other hand, Los Angeles area refiners are reported thoroughly fed-up with current political game being made out of smog wrangle (What's Happening, Nov., p. 1624). Feeling is any future growth has to be in northern California or Pacific Northwest, but not in Los Angeles.

. . . **Uniform flammable liquid codes** are being sought by a National Fire Protection Assn. subcommittee. Group is undertaking study aimed at bringing order out of the "confusing field of classification and testing procedures for flammable liquids."

Standards under study include those concerned with: fuel oil storage tank spacing limits; steel diking; storage of small containers of various sizes.

In the Petroleum Industry

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PARADYNE	Secondary Butyl Acetate	Decyl Alcohol
PARATAC	Isopropyl Acetate	Tridecyl Alcohol
PETROHOL	Acetone	Dicyclopentadiene
Methyl Ethyl Ketone	Methyl Ethyl Ketone	Isoprene
Dewaxing Aid	Ethyl Ether	Butadiene
Ethyl Ether	Isopropyl Ether	Ethyl Ether
Isopropyl Ether	Dicyclopentadiene	Isopropyl Ether
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		Benzene
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 (To obtain more data on advertised products see page 1936)

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THE CASE HISTORY

Valves formerly used here were identical in design and appearance with their Crane replacements. But the similarity ended there. For they gave continual trouble in this round-the-clock process. Sticking discs made them extremely difficult to operate. They failed to hold tight on closure. Their replacement became mandatory for efficient operation.

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Widening Markets Seen for LPG With Its Success as Motor Fuel

LIQUEFIED petroleum gas has a bright future as a fuel for motor buses, according to representatives of three different municipal transportation systems. Favorable results after three or more years of operation were reported at the recent meeting of the Society of Automotive Engineers' Fuels and Lubricants group, November 4-6, in Chicago.

Fuel savings per mile of operation ranged from 0.87 to 1.5¢ in comparison to gasoline-operated coaches and were about 0.36¢ in comparison to diesel-operated vehicles. Fleets ranged in size in accordance with the cities reporting—Wichita, Kans.; San Antonio, Texas; and Chicago, Ill.

Wichita, with a fleet of 131 buses, has been operating 91 of these vehicles on propane over 3½ years. Its fuel cost per mile on gasoline buses averages 4.237¢; on propane buses, 3.366¢.

San Antonio has a propane fleet of 172, comprising about 57% of its total fleet. However, the city operates 80% of its bus mileage on propane. Since January, 1951, these buses have operated 18,000,000 miles with a fuel saving compared to gasoline of 1 to 1.5¢ a mile.

Gross savings amount to $225,000, figured on a 1¼¢/mile average saving. Conversion of existing buses, purchase of new ones, and construction of storage and dispensing facilities for propane totaled almost $200,000. Pay-off has therefore been reached in less than 3 years. And system officials figure they still can expect 20-30 years of life from storage facilities and 7 to 9 years of service from the buses.

Chicago has piled up some 50,000,000 miles of propane operations in 2½ years; now has some 550 propane-powered buses and recently ordered 400 more. Last comparative check on fuel costs between propane and diesel showed 3.784¢/mile for propane and 4.148¢/mile for diesels.

Other advantages for propane cited by all three operators have been: excellent public acceptance—no exhaust smoke or obnoxious odors; less frequent oil changes—twice the mileage between changes; increased sparkplug life; no crankcase dilution or sludging, even with protracted idling; decreased carbon formation, and cleaner engines in general.

Low fuel cost itself has been admittedly an important factor in successful LPG bus operation in these three cities. In Wichita, cumulative cost of propane in 1952 was 11.58¢/gal.; San Antonio reported a price differential between propane and gasoline of a little over 5¢/gal. In Chicago, propane's price advantages were 5.6¢/gal. over diesel fuel and 6.96¢/gal. over gasoline. In addition, Chicago has set up a 5-year propane fuel contract with assurance of maintaining essentially the same price spread.

Possible disadvantages in form of fire hazard problems have been licked by all three municipalities by building propane facilities in conformance with local and national codes, and working in close cooperation with fire prevention organizations.

These three fleets, plus a few others who have been operating propane buses for even longer periods of time, represent of course a very small drop in the bucket of a country-wide market. And country-wide, numerous other factors can enter into the picture of LPG's potentialities as an automotive fuel. However, when favorable reactions come from so many different sources, petroleum processors can well expect some changes in the demands on their LPG products.

—W. C. U.

Urea Compounds May Be Solution To Wide-Temperature Greases

TRENDS in grease technology may follow a number of new and promising avenues of approach in the future, among them the use of urea compounds as means of improving product qualities.

One problem, for example, that faces the grease compounder has been to produce a grease with long service life over greatly widening ranges of temperatures. In industry, high temperatures are encountered in steel manufacture—in kiln-car and oven-conveyor bearings, rolling mill motor bearings, and equipment used with quenching baths. In military aircraft, high temperatures result from the use of jet engines, higher speeds, and size reduction of accessory equipment; extreme cold is encountered at high altitude and in arctic operations.

Greases may fail to meet expectations for wide-temperature range use because of deficiencies in the fluid or thickener, or the incompatability of these components. Petroleum hydrocarbons and fluorcarbons have been found to have too narrow a liquid range, diesters are liquid over a wide range but are too volatile at high temperatures, and silicate esters are subject to hydrolysis. One type of silicone, methyl phenyl polysiloxane, despite poor lubricity, appears to be the best fluid for the purpose.

Even in silicone fluid, few thickeners are satisfactory for use at 450° F. Soaps are satisfactory for high speed but have low melting points. Inorganic thickeners are not suitable for high-speed use, and those rendered organophilic by organic coatings are unstable above 300° F. Of the organic materials that approach the desired properties, copper phthalocyanine perhaps has the widest utility, but even it does not give entirely satisfactory service in high-speed ball bearings at 450° F.

In work done by Standard Oil Co. (Indiana) and the Wright Air Development Center, and reported by the oil firm at the 21st annual meeting of the National Lubricating Grease Institute in Chicago in October, the substituted ureas appear to have the desired properties of high melting point and thermal stability.

A variety of these compounds can be made by varying the groups attached to the urea linkage: among them: alkylmonourea, alkyldiurea, alkylarylmonourea, arylmonourea, aryldiurea, alkylaryldiurea. Arylureas

are higher melting and more stable than the alkylureas; many melt above 600° F.

Satisfactory greases—more than 50 of them—were made with the urea thickeners and the silicone fluids. Most of the individual properties resemble those of common soap-petroleum greases. In two important respects—evaporation and thixotropy at high temperature—arylureas surpass other silicone greases. In performance tests other than gear wear, they are exceptional.

Fly in the ointment thus far has been some sacrifice of lubricity. Experts do not close the door, however, on eventual success in attaining proper values of this factor. —W.C.U.

Incentive for Recovering Aromatics Boosted by New Route to Styrenes

A NEW development in aromatics chemistry may sop up more of the xylenes and also give an added incentive for toluene recovery from aromatic-rich petroleum fractions.

The latest development is synthesis of methyl and dimethyl styrenes by a two-step process,[1] reportedly more complicated and versatile than the Dow method involving alkylation of toluene with ethylene and subsequent dehydrogenation of the new side-chain. Developed by American Cyanamide, the new process utilizes toluene to produce methylstyrene (vinyl toluene) or a mixture of xylenes to produce dimethyl styrenes.

For vinyl toluene the starting materials involve reacting two mols of toluene with one of acetylene in the presence of sulfuric acid to produce isomers of 1,1-ditolylethane. This mixture then is cracked over unspecified clay catalysts to yield *o*- and *p*-methylstyrenes with toluene itself. Acetaldehyde could be used instead of acetylene, but this involves preparation of the former from the acetylene unless the heat of reaction and well-known "orneriness" of the acetylene in the methylstyrene synthesis proves difficult to cope with. The toluene is of course recycled.

Different actors but the same procedure is used in making dimethylstyrenes. The starting material is a commercial mixture of xylenes. Acetaldehyde is preferred to acetylene to achieve a better balance of dimethylstyrene isomers for polymerization purposes. The product is an isomeric mixture of dixylethanes, which is then cracked to produce dimethylstyrenes and xylenes.

A by-product of dimethylstyrene synthesis may prove to be a good source of more *p*-xylene. It so happens that the *m*- and *o*-isomers of xylene are more reactive in the synthesis than *p*-xylene, and hence are preferentially removed from commercial xylene mixtures. As synthesis proceeds, the *p*-isomer tends to concentrate in the cracking residue until commercial crystallization techniques for its recovery become practical.

It thus would appear that oil companies providing these relatively new petrochemical isomers, either separated or in mixture, can be assured of good markets. This possibility is of particular interest since a part of the national concern over segregation of the aromatic cuts from which they come was predicated on wartime use, while demand now developing is based principally on civilian consumption of the end-products. —D. P. T.

(1) *Chemical Week*, P. 41, Oct. 24, 1953.

Petroleum and Atomic Energy—Partners or Competitors?

ATOMIC energy and the oil industry are not seen as being generally competitive—in fact, they are in many ways thoroughly complementary. However, there are three categories where it is entirely possible that atomic fuel will be more economical than a petroleum product. As foreseen by W. L. Davidson, director of the office of industrial development, U.S. Atomic Energy Commission, these include:

1—Oil- or gas-fired boilers for process heat or for electric power production, in the range of 100,000-kw capacity or more.

2—Diesel-powered electric plants in the capacity range of 5,000 to 25,000-kw.

3—Large prime movers, particularly for ships and large aircraft.

Because of so-called "critical-size" considerations and shielding requirements, it seems safe to assume that certain fields exist where atomic energy will not compete with petroleum as fuel, Mr. Davidson said in his talk at the 33rd annual meeting of the American Petroleum Institute in Chicago last month.

Such fields include the packaged-power field covered by units of 1 to 1000 hp. equivalent. This means that automotive equipment, small naval craft, most aircraft—and probably even locomotives—as well as home-heating units, are not economically feasible with atomic energy. And, by the very nature of things, the petroleum industry has no cause for concern that atomic energy can preempt any of the growing petrochemical field.

Partnership possibilities for oil and the atom are also growing steadily, Mr. Davidson said, citing the many current petroleum industry uses for atomic energy in its various forms. Charles A. Thomas, president, Monsanto Chemical Co., also speaking at the API meeting, suggested, for example:

1—The possibility of making gasoline from natural gas simply by using ionizing radiation at the proper temperatures and pressures.

2—Possibility of entirely new petroleum products through the use of atomic radiation in processing. This is not unreasonable because radiation as well as heat affects certain chemical reactions. As a minor example: certain polymers have improved characteristics after exposure to certain kinds of radiation.

Private industry must take the initiative in developing peaceful uses of atomic energy, however; otherwise the leadership in this field might be lost to other countries, Dr. Thomas warned. —W.C.U.

Control of Steam to Vacuum Jet

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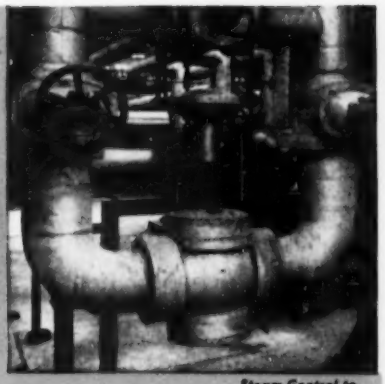

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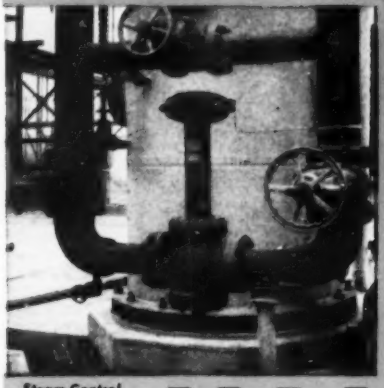
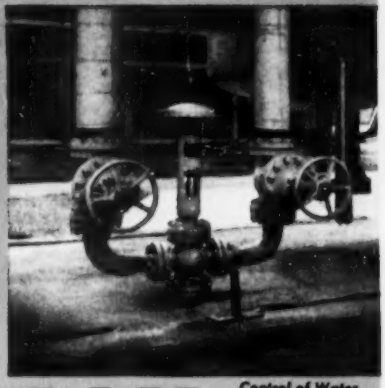


Steam Control to Reboiler



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And Santopoid 33 offers an important extra —its foam-inhibitor content. Santopoid 33 contains a stable anti-foam agent that retains effectiveness over long periods of storage. Enough stable anti-foamant is present in Santopoid 33 so that the final gear-lubricant blend is permanently protected against foaming in service.

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MONSANTO
CHEMICALS—PLASTICS

Letters

Combination Processing

TO THE EDITOR: Our refining people at Standard Oil have read the article "Combination Processing Can Cut 22% Off Investment Costs" [October, pp. 1505-1510], with more than usual interest since over a year ago we conducted a rather extensive study of integration versus non-integration, as we call it. As a result of this study the design of our new 30,000 b/d refinery now under construction at Mandan, N. D., embodies not only a combination of crude running, catalytic cracking, vapor recovery, and catalytic polymerization, but also carries through the integration concept from the receipt of crude into the refinery to the shipment of products.

You can see, therefore, that we heartily concur with the general conclusions reached in the above article. Continuous improvement in investment and operating costs is a "must" in the highly competitive oil industry. We not only anticipate widespread adoption of combination processing as it now stands, but also expect that complete integration of refining facilities will become a highly developed technique.

M. G. PAULUS
Vice President, Mfg. Dept.
Standard Oil Co. (Ind.)
Chicago, Ill.

Cumene Catalyst

TO THE EDITOR: In the September 1953 issue of PETROLEUM PROCESSING you published an article by Mr. P. W. Sherwood on "Synthetic Phenol Manufacture." This article included a section on the isopropylation of benzene for the production of cumene and stated that two processes have served in the commercial production of cumene, namely: the orthophosphoric acid catalyst system and the sulfuric acid catalyst process.

The review of cumene production failed, however, to mention copper pyrophosphate as a catalyst. Copper pyrophosphate is a catalyst which was developed in the laboratories of the M. W. Kellogg Co. and which was used in four cumene plants designed by Kellogg during the early part of World War II. These plants were at Toledo, Ohio, for Standard Oil Co. of Ohio; at the Lemont, Ill., refinery of Globe Oil and Refining Co.; at W. Tulsa, Okla., for Mid-Continent Petroleum Corp.; and at El Dorado,

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Kans., for Skelly Oil Co. During the period of World War II, these four plants were outstanding producers of cumene.

In addition to this and to additional post-war experience, Kellogg currently has under construction for Hercules Powder Co. at Gibbstown, N. J., a cumene plant which will employ copper pyrophosphate catalyst as part of the complete facilities for phenol production which are being built by Kellogg for Hercules at that location.

The plants which we designed during World War II produced cumene for aviation gasoline and such cumene had slightly different specifications from that required for phenol production by the cumene hydroperoxide process. The copper pyrophosphate catalyst which is used in all six plants gives a considerably purer cumene product than is obtained with other alkylation catalysts and, in addition, results in superior yields of cumene based on benzene. As an illustration, the review in your journal mentions over-all cumene yields from the processes described in the range of 90-93%, whereas data available to Kellogg indicate yields in the range of 95-97% when copper pyrophosphate catalyst is employed.

BENNETT ARCHAMBAULT
Vice President and General Manager
The M. W. Kellogg Co.
New York, N. Y.

It's Not Asphaltic

TO THE EDITORS: Your July 1953 issue carries on p. 1044 in an article by D. P. Thornton, Jr., on "Air-Oxidation of Butane" the following statement:

"Among interesting features of construction are the extensive use of asphaltic-base paint ('Bitumastic') to minimize corrosion and the use of color-coding for utility lines . . ."

We appreciate your putting our "Bitumastic" trademark in quotes to identify it as a trademark. We wish that other editors were as considerate in avoiding its use in a generic sense.

However, if you have future occasion to refer to it, we would like to correct the impression that the product marketed under our "Bitumastic" trademark is an asphaltic-base material. This product is actually a coal-tar product and not a petroleum product as implied by the term "asphaltic."

W. J. MONACELLI
Manager, Patent Section
Koppers Co.
Pittsburgh, Pa.

PETROLEUM CHEMICALS DIVISION
NEWS

December ★ One of a Series of Interest to the Petroleum Industry ★ 1953

Use of Antioxidants Cuts Sweetening Costs

With operating costs continuing to rise and the consumer gasoline market becoming more competitive every day, you are probably looking for every possible opportunity to cut production costs—without sacrificing quality.

The use of antioxidants for sweetening offers just such an opportunity. If you are starting from scratch, the initial cost is low because a minimum of equipment is required to set up the operation. Or, if you employ existing equipment, the cost of revamping is exceedingly low since antioxidant sweetening is a simple procedure.

Operating costs are lower, too, because the use of Du Pont Antioxidant No. 22 reduces regeneration expenses and the need for additional chemicals.

Other Advantages

Since antioxidant sweetening does not require the use of sulfur or copper, the chance of contamination from these elements is eliminated – unless the gasoline comes in contact with them in some other way.

And since Du Pont Antioxidant No. 22 is highly effective as a stabilizer, you can combine two important steps into a single, inexpensive operation when you use this additive as a sweetening agent.

No Gasoline or Octane Loss

Some sweetening methods result in a definite loss of gasoline or octane number. But there is no loss of either product or quality when Du Pont Antioxidant No. 22 is used in the sweetening process.

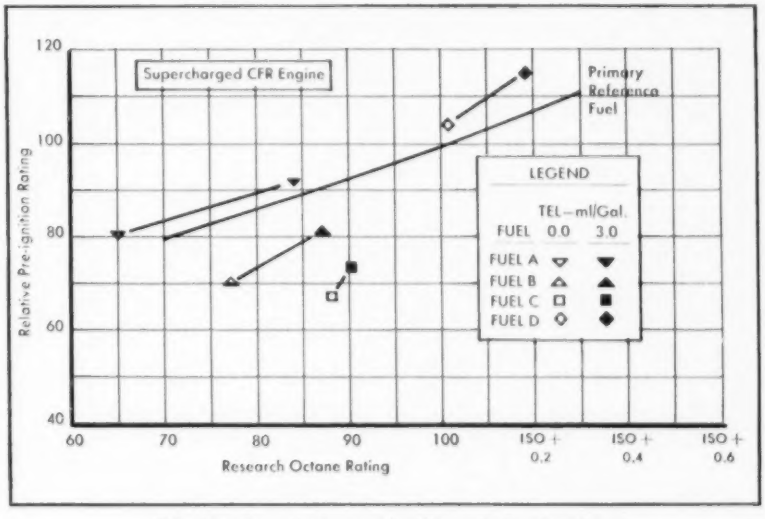
Du Pont Antioxidant No. 22 is N:N'-di-secondary butyl-para-phenylenediamine. Samples of it and additional information on antioxidant sweetening are available through any Du Pont Petroleum Chemicals Division district office.

You can reduce both knock and pre-ignition with one additive

Recent tests at the Du Pont Petroleum Laboratory show that TEL not only inhibits the reactions leading to knock, but also the reactions causing pre-ignition

With the compression ratios of automobile engines steadily rising, the problem of finding methods to eliminate or suppress pre-ignition is becoming increasingly important to the petroleum industry.

To help refiners solve this problem, extensive research in pre-ignition is now being done at the Du Pont Petroleum Laboratory. Much useful information has already been developed.



This chart shows the increased resistance to knock and pre-ignition due to the addition of tetraethyl lead in several fuels.

So far, the solution to the problem has been sought in the following two ways:

1. Reducing the tendencies of combustion chamber deposits to glow and cause surface ignition of the charge.
2. Improving the ability of fuels to withstand ignition by such hot surfaces.

Reducing Glow

Certain additives reduce deposit glow and therefore offer one solution to the problem. However, as engine compres-

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OVER

DU PONT

PETROLEUM CHEMICALS DIVISION
NEWS

DU PONT

CONTINUED *Pre-ignition*

sion ratios are increased still further, it may also be necessary to increase the pre-ignition resistance of the fuels themselves.

Resistance of Fuels

Some hydrocarbons have a greater tendency to be ignited by hot deposit particles than others. Preflame reactions also tend to sensitize the fuel to ignition.

Effect of TEL

The effect of these preflame reactions can be minimized by raising the octane rating of the fuel with tetraethyl lead. In this way, *tetraethyl lead* not only prevents knock . . . but *also reduces the tendency for the fuel to be ignited by a hot surface.*

More Information

More complete details on the Du Pont Petroleum Laboratory's pre-ignition studies are now available to you through any Du Pont Petroleum Chemicals Division district office. Ask for papers entitled "Pre-Ignition in Automotive Engines" and "An Investigation of Pre-Ignition in Engines."

New Lube Oil Show to Help Marketers Stimulate Dealer Promotion

A new lube oil presentation for dealer meetings is now being made available to oil marketers by the Du Pont Petroleum Chemicals Division.

It is especially designed to help you impress your dealers with the value of promoting more frequent oil changes. The same "flannelboard" visual-aid technique as used for the highly successful Du Pont-designed *Brand Name* program is employed for putting across this new promotional tool.

The general theme of the show is: "Good oil seldom wears out . . . but it can become dirtied to death." The individual points emphasized in the presentation can be personalized to bring out the special quality features of your own brand of motor oil.

If you are interested in having one of these personalized lube oil presentations made up for use in your own dealer meetings, we suggest that you talk over the details with a Du Pont Petroleum Chemicals Division representative.

Assistant West Coast District Manager

WILLIAM B. GEST, recently appointed assistant manager of the Petroleum Chemicals Division's West Coast district, has been with the Du Pont Company since 1941.

Until 1945 he served in various engineering capacities at a number of Du Pont-operated government ordnance plants. He then spent two years doing cost engineering work in the Engineering Division and at several company plants.

He joined the Petroleum Chemicals Division in 1947 as a sales-service representative.

Mr. Gest studied engineering and military explosives at Ohio State University, where he also received a B.S. degree in Business Administration.

WILLIAM B. GEST

Du Pont Test Cars Show How to Take the "Toll" Out of Toll Roads

Super highway toll roads and fuel test cars have both been around for a long time.

But it took the ingenuity of a major oil company to put the two together and come up with some amazing results.

When the Garden State Parkway in New Jersey was opened last summer, two Du Pont test cars were on hand for the official opening ceremony. Their job, however, was far more important than merely looking decorative in the official caravan.

Sponsored by one of the large oil companies marketing in the New Jersey area, the cars were used to show the Highway Authority how the new parkway saves the motorist 40% on gasoline mileage and at least 25% in time when compared with the old traffic-congested route.

After the results of the test had been tabulated, the Garden State Highway Publication declared that motorists will save more than the parkway toll by using the new road because of the gasoline savings it makes possible.

LITERATURE AVAILABLE

Here is a partial listing of the bulletins, reports, booklets, technical papers and aids available to you through any of the Du Pont Petroleum Chemicals Division district offices listed below:

Pre-Ignition in Automotive Engines — This paper discusses mainly the glowing tendencies of combustion chamber deposits and the pre-ignition tendencies of individual hydrocarbons Serial A-5652

An Investigation of Pre-Ignition in Engines—A comprehensive discussion of how compression ratios and other mechanical factors affect pre-ignition. Also the effect of tetraethyl lead in reducing pre-ignition Serial A-5756

Du Pont Fuel Oil Additive No. 2—A 12-page bulletin describing this ashless stabilizer and dispersant which prevents clogging of fuel oil screens Serial A-5201

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A COMPLETELY NEW CONCEPT IN CONTROL VALVE DESIGN..

BODY RATING TO
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FLOW RANGEABILITY
C_V .000001 TO 0.1

1 Substantial forged alloy (wide selection) valve body.
2 Rugged all stellite, easily removable, Flo-Mike valve seat.
3 Direct positive seal, inlet tubing to valve seat connection.
4 Hard chrome-plated, super finished valve stem with stellite plug.
5 Annin "Super VO" stem seal assembly.
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11 Cross head pre-loading spring, eliminating lost motion.
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And now — Annin's "Wee Willie" — new in concept and design, providing the Research and Development engineer with a pilot plant instrument having a water Cv range from .000001 to 0.1 with control of pressures to 50,000 PSI. Unique design minimizes distortion, stretching, and friction. The time-proven Series "A" Domotor power unit provides precise and positive control under all conditions. "Wee Willie" may be the answer to your problems in the high pressure field. Investigate this new valve today!

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Answers to

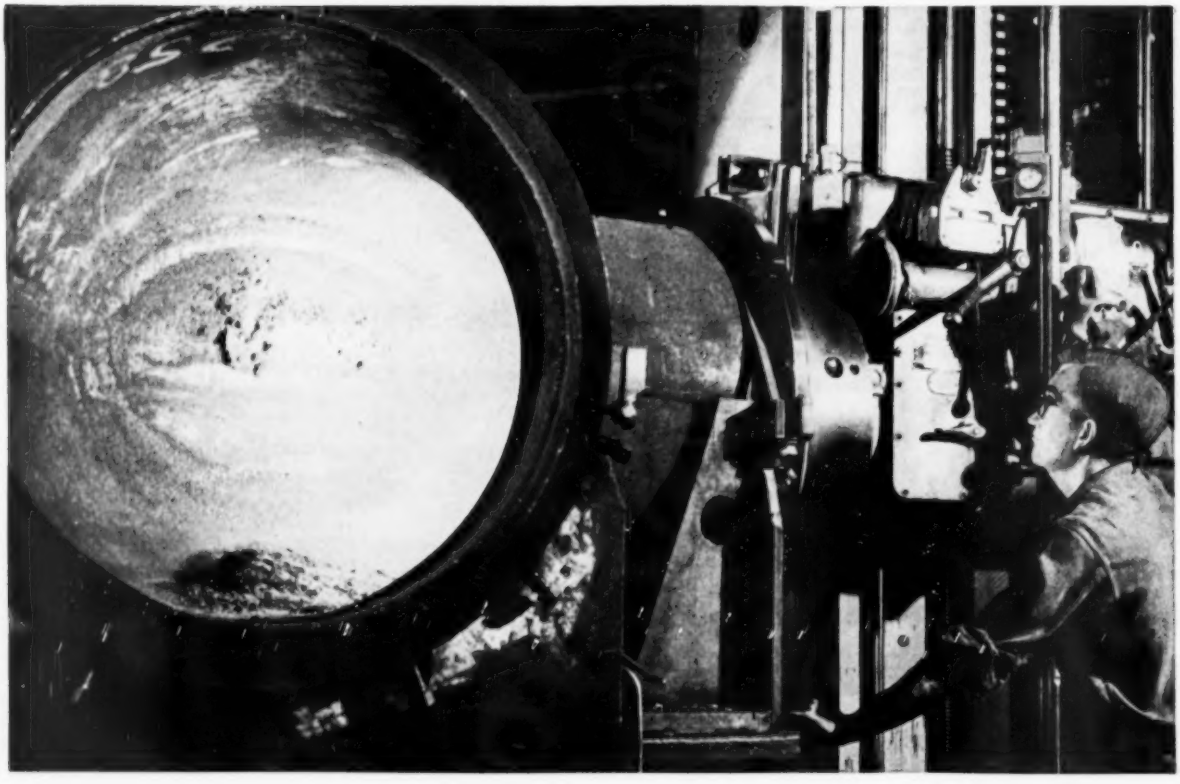
...in power, processing,

Among the many problems solved by equipment shown on these pages, one or more may be related to your own.

When such problems arise, call on the experience gained by Alco in designing and building an endless variety of equipment for plants and municipalities the world over. Call on the complete, modern production facilities that enable Alco to meet *economically* your strictest specifications.

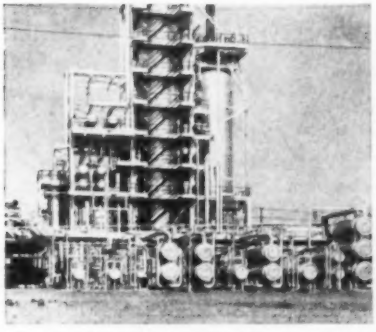
Your nearest Alco Products sales representative will be happy to give you full information in terms of your own requirements. Contact him at New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa or Beaumont.

WITH MODERN PRODUCTION FACILITIES capable of handling virtually every type of metal fabricating operation, Alco can help you solve your toughest heavy-equipment problems. Here, using a special jig, an Alco craftsman faces a flange on a 42-in. smooth-flow pipe elbow that was formed to size on Alco's 750-ton press.

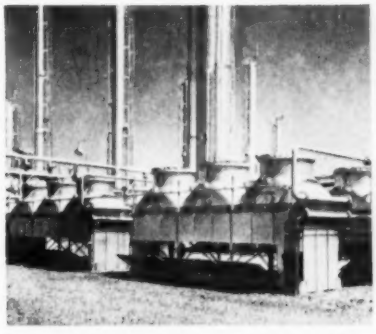


New Industrial Problems

water supply

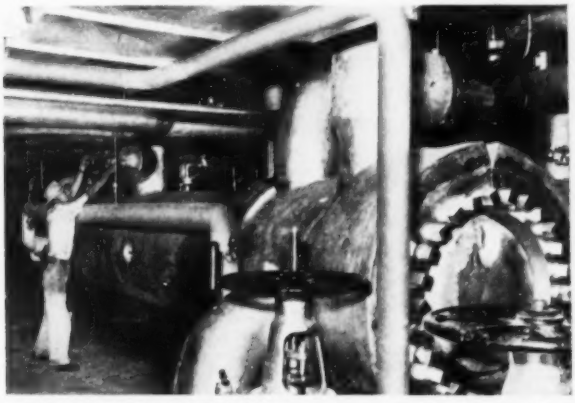


SPECIAL HEAT EXCHANGERS, designed and built by Alco to meet individual customer requirements, help boost efficiency, cut operating and maintenance costs on Carter Oil Company crude unit at Billings, Montana.



ALCO AIRCOOLERS used in the modern pressure maintenance and processing plant operated by Stanolind Oil & Gas Company at Elk Basin, Wyoming. These rugged, versatile units are unsurpassed for efficient heat dissipation in arid regions.

MORE THAN 200,000 FT of durable, economical Alco Electric Welded Steel Pipe, ranging in diameter from 20 to 72 in., have been installed over the years as part of the gigantic water-supply system of New York City.



ALCO FEEDWATER HEATERS, some incorporating special Alco-designed desuperheating and subcooling sections, contribute to the efficiency of the Carolina Power and Light Company's new 150,000-kw plant at Goldsboro, N. C.

PRESSURE-SEALED STEEL CONTAINERS for jet engines, assembly-line produced for the U.S. Air Force, illustrate Alco's ability to design and build special metal equipment to almost any specifications, in almost any quantity.

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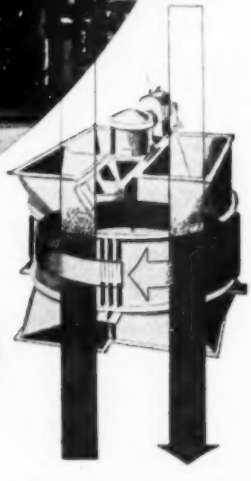
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK

with the

Ljungstrom Air Preheater



The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

In every processing vessel that burns fuel, air preheat shows the way to save as much as *one barrel out of every five*. When refineries alone burn over 200,000,000 barrels every year, this means the *Ljungstrom Air Preheater* can recover tens of millions of *production dollars* that are now going up the stack.

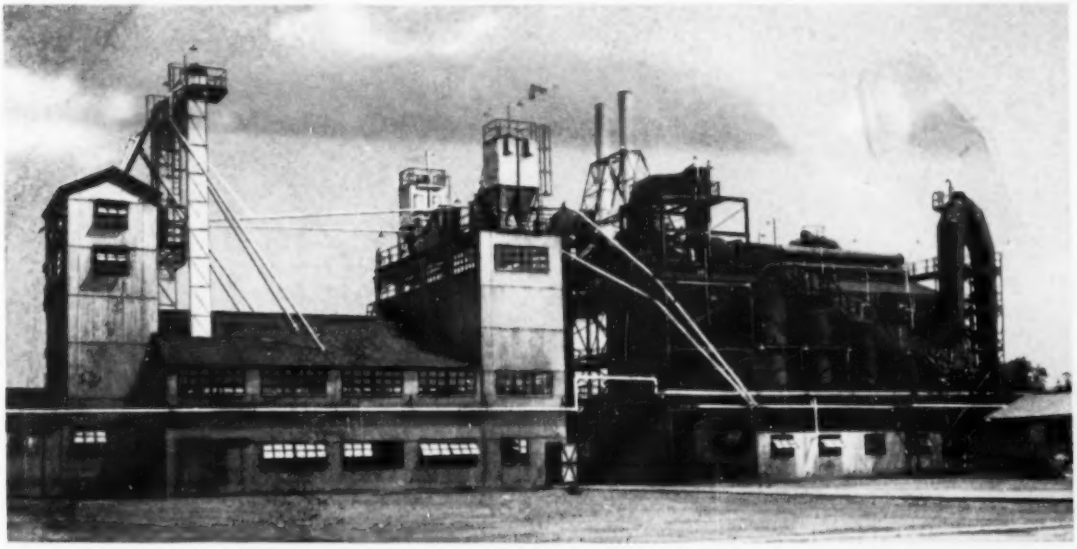
The Ljungstrom removes precious BTU's from exit gases and transfers them to combustion air. Its effectiveness can be gauged from the fact that every 35-40°F of preheat means roughly a 1% saving in fuel—and Ljungstroms now in use preheat air to over 600°F.

In addition to saving as much as 20% of your fuel, more effective fuel utilization means that your equipment can deliver greater throughput . . . can burn lower grade fuels with less slagging . . . lets you eliminate convection surfaces without reducing production.

In these days of high fuel costs, every process industry should consider the Ljungstrom for new installations or modernization of existing equipment. Call or write The Air Preheater Corporation for full details.

Wherever You Burn Fuel, You Need Ljungstrom

THE AIR PREHEATER CORPORATION 60 East 42nd Street, New York 17, N. Y.



NEW INDUSTRY *for Canada*

The Furnace Carbon Black plant of Cabot Carbon of Canada Ltd. is Canada's first oil furnace carbon black plant.

The principal process equipment was designed by Cabot Engineering Company of Pampa, Texas, affiliates of Cabot Carbon of Canada, Ltd. Stone & Webster Canada Limited, with the assistance of Stone & Webster Engineering Corporation, furnished consulting services and constructed the plant.

STONE & WEBSTER ENGINEERING CORPORATION

Affiliated with STONE & WEBSTER CANADA LIMITED

Cabot Carbon of Canada Ltd.'s new plant at Sarnia, Ontario, supplies high abrasion furnace black and fast extruding furnace carbon black for Canadian-made tires and other rubber goods.

what's the cost in the long run?

This important question should be foremost in the mind of every petroleum refiner when he is considering large capital investments in petroleum refining facilities.

The installation of a refining process is an important step that merits the careful consideration of every factor affecting refinery economics over a substantial period of time. Consequently, the investor should be vitally concerned with the extent of continuing

service available through the company with which he is dealing.

While the selection of a refining process, and the construction of each component are matters of extreme importance, the extent of service that the refiner can actually count upon after the process is operating should not be dismissed without very careful investigation.

Universal invites, and suggests that every petroleum refiner make an impartial comparison of the many services available through its broad and comprehensive program, and the services offered by other organizations now in the business of licensing petroleum refining processes.

Your own answer to . . . . What's The Cost In The Long Run . . . . should reveal the most economical and profitable course to follow.

UNIVERSAL OIL PRODUCTS COMPANY

30 ALGONQUIN ROAD, DES PLAINES, ILL., U.S.A.

Laboratories: RIVERSIDE, ILLINOIS

Universal Service Protects Your Investment

How To Solve Corrosion Problems

PROBLEM: Protecting a preheater from corrosive attack during periodic contact with hydrochloric acid, trichlor benzene, and other chlorine compounds at 300 deg. F.

REMEDY: Complete lining with HASTELLOY alloy C 11-gage sheet.

RESULT: The vessel has given four years' service and is still going strong.

PROBLEM: Valving sulphur-laden flue gas at 800 deg. F. and 300 psi.

REMEDY: A $\frac{1}{8}$-in. layer of HASTELLOY alloy B was applied to seats and seating surfaces.

RESULT: The valves gave over four years' service despite the corrosive conditions.

Free: Money-saving jobs like these are described in detail in the monthly magazine HAYNES ALLOYS DIGEST. To receive a copy regularly, write Editor, HAYNES ALLOYS DIGEST, Room 308, 30 East 42nd Street, New York 17, New York.

HASTELLOY *alloys*

Trade-Mark

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe, cast pipe and pipe fittings, sand and precision-investment castings.

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

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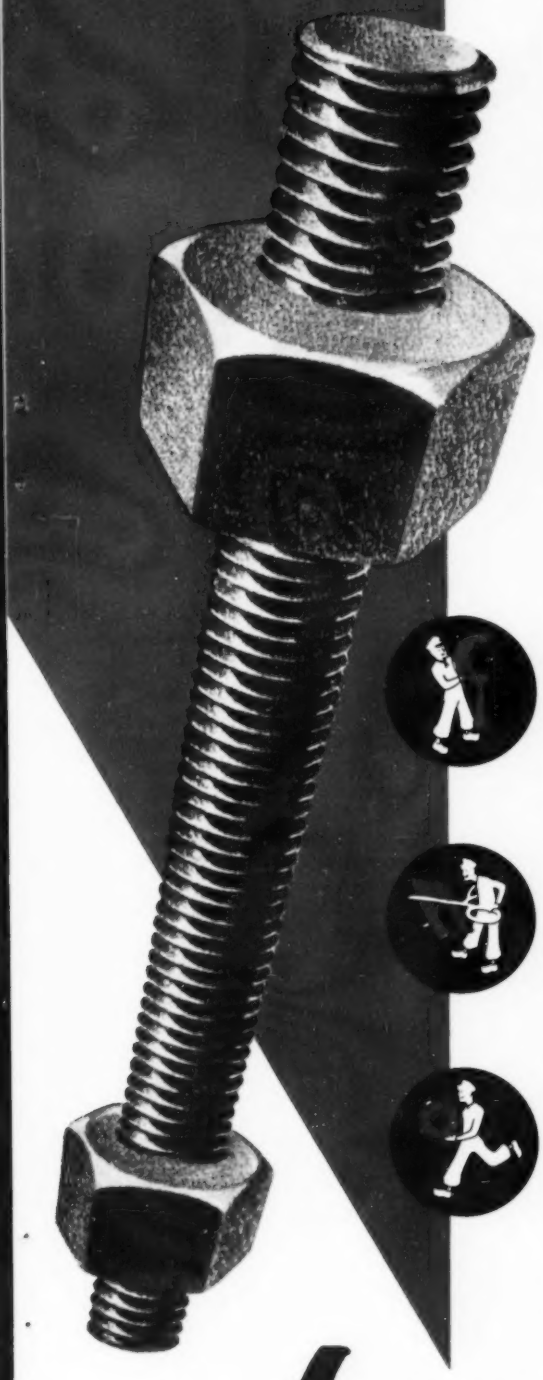


Dutch industry makes American standard fasteners for the oil industry

QUALITY Five ultra-modern Dutch factories are banded together to produce the world-renowned VvS nuts and bolts made to American specifications. The fasteners industry of Holland has led in efficiency, dependability and precision for more than 100 years. The quality of Dutch VvS products is unsurpassed. Leading U. S. testing laboratories certify the quality of VvS products on *American standards* of metallurgy, dimensions and finish. For example, the oil industry in the United States and Canada is widely using Heat Treated and Oil Quenched VvS nuts. These products meet ASTM specifications A-194 of course, and are particularly outstanding in finish.

PRICE Dutch efficiency and dependability make it possible to supply VvS nuts anywhere in the world on a competitive basis. The oil industry has used fasteners from the VvS member factories since its very beginnings. American oil and gas industry purchasers of nuts, bolts and fasteners are invited to compare VvS price lists with any others.

DELIVERY VvS factory organizations take pride typical of the Dutch in their ability to meet delivery deadlines. Orders placed with Reynolds Fasteners, Inc., in America bring fast and dependable shipments from the stable VvS plants, where technician, craftsman and workman alike are given opportunities, incentives and working conditions ranking with the best Europe can offer. Plants and equipment facilities are being enlarged in pace with the steadily growing stream of business coming to VvS.

The exclusive Sales and Service Representative for VvS in the United States and Canada is

Reynolds FASTENERS, INC.

VvS

68 Wall Street
New York 5, N. Y.
Phone DIgby 4-7444
Cable REYNFAST, N. Y.

In Canada associated with
Kenway Metal Products, Ltd.
21 King Street East
Toronto 1, Ontario

(See next page)

Advertisement

Reynolds FASTENERS NEWS

ABSOLUTE QUALITY STANDARDS

VvS fasteners for the American oil and gas industries are produced strictly in line with ASTM standards as to metallurgy, dimensions, finish. Their qualities are verified by leading U. S. independent testing laboratories. American stud manufacturers are giving immediate and wide acceptance to VvS nuts of both Classes 2 and 2H. Their absolute quality is enhanced by unrivalled finish, including true washer surface and smooth outside surfaces, and a balanced hexagon shape.

VvS quality is the result of Dutch pre-eminence in the fasteners field. The VvS Heat Treated, Oil Quenched nuts are made on the famous Van Thiel hot pressing equipment, acknowledged to be one of the major advances in nut making. VvS craftsmen have the advantage of more than a decade of experience with this and other Dutch-developed equipment.

Currently Reynolds Fasteners is booking orders for VvS nuts in sizes of ¼-inch to 3½-inches. The VvS factories are equipped to supply the American market with *a complete range* of fasteners, including Hexagon Head Cap Screws in both 1020 and 1038 steel, in sizes from ¼-inch to 1½-inches; Hot Pressed Nuts from ¼-inch to 4 inches; Semi-Finished Nuts up to 4 inches; Machine Screws; Machine Screw Nuts; Socket Head Cap Screws, and other standard or special types of fasteners.

So diverse are the facilities of the five Dutch factories that inquiries on any type of nut, bolt or fastener are invited for study and prompt reply.

Do you know what Verkoopkantoor voor Schroefbouten N.V. means?

A workable translation for this marathon phrase, usually shortened to VvS, is *Combined Sales Organization of Bolt and Nut Factories in the Netherlands.*

VvS represents an alliance of virtually the entire Dutch bolt, nut and fasteners industry, a field in which the Netherlands has long been a leader. Five factories operate under the VvS banner, employing more than 2000 persons, each factory organization representing a modern, top-flight producer of fasteners. VvS means Sales and Service effectiveness, insurance of Quality and dependability of Delivery.

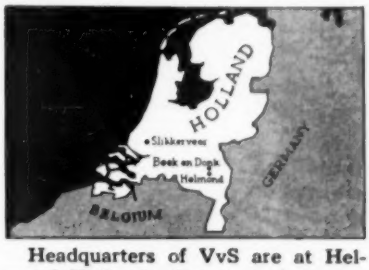
The combined sales efforts of the Dutch factories commenced in 1934. For nearly a score of years the teamwork of this precision industry group has earned for VvS the admiration and patronage of the most meticulous manufacturers and fabricators in the world.

ABOUT REYNOLDS FASTENERS, INC. As exclusive representatives for VvS in the United States and Canada, the Reynolds organization brings the American oil and gas industries a solid, nearby link between a pre-eminent supplier industry abroad and the men who establish the requirements and standards for equipment for oil fields, refineries, oil and gas process installations, storage, pipe lines, and distribution. American oil and gas facilities are designed to be the best anywhere. It is to this level of quality that VvS has gauged its production of American standard fasteners.

Reynolds personnel are well grounded technically, intimately informed and up-to-date on the qualifications of the VvS member factories and people. Moreover, the Reynolds people are experts in handling the import of precision products. Reynolds is an affiliate of long established firms which for years have specialized in the import of precision metal and engineering products—the best the world offers for American industry. Reynolds offices in New York, Toronto, Paris and The Hague provide sales and technical services for American fasteners applications anywhere in the world. The Reynolds staff is well qualified for rapid, accurate handling of mill orders which bring shipments direct from European ports to the North American ports of entry and railheads for suppliers to the oil and gas industries.

GETTING IN TOUCH WITH REYNOLDS Your inquiries as to details on VvS fastener products for your individual needs should be addressed to Reynolds Vice President for Sales, Mr. Binem Krygier, at the New York office. Mr. Krygier, a widely experienced and informed engineer, and his staff travel frequently in the oil and industrial capitals of the U. S. and Canada. They will schedule a visit to your office on one of the sales and service itineraries, at your convenience.

ABOUT PRICES Any buyer is very much interested in prices and in the case of items produced abroad wants to know why Dutch-made specialty products offer advantages of their own. Price-wise Reynolds believes the VvS products compete with the best. Further, the exclusive machinery and methods of the Dutch give a particularly accurate and beautifully finished product. The Dutch toolmakers of VvS can't be beat for advanced design and efficiency. If the prices are right, there just isn't any question about quality or delivery. VvS goes to work on a stable, agreed schedule of production and shipments. Reynolds experience with American customers will be laid before you for judgment.



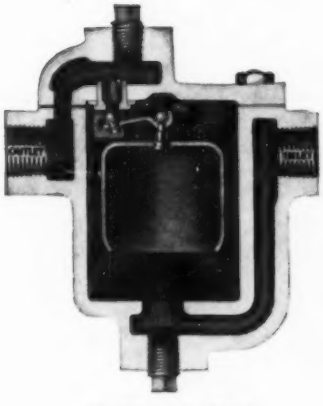
Headquarters of VvS are at Helmond, Holland, where two of the factories are located; the other three factories are at Beek en Donk and Slikkerveer (see map sketch). VvS officials welcome visits of American industrialists at Helmond if you are traveling abroad. Let them know you are coming to see VvS showrooms and headquarters through Reynolds Fasteners, Inc.

REYNOLDS FASTENERS, INC. • 68 WALL STREET • NEW YORK 5, N. Y. • PHONE DIGBY 4-7444

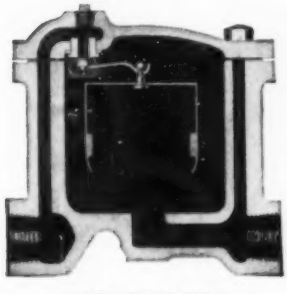
DOUBLE DRAINAGE

AT LOWER COST WITH

Clark DUO-STEP Leverage



CLARK 60-D TRAP



CLARK 70-D TRAP

FAMOUS DUO-STEP LEVERAGE IS NOW AVAILABLE FOR THE FIRST TIME ON THESE SMALLER SIZED STEAM TRAPS. GET HIGHEST DRAINAGE CAPACITY AT LOWEST COST.

Duo-Step is the revolutionary double fulcrum principle that affords maximum leverage to "crack" the valve from the orifice seat, teamed with "Follow-through" power that opens the orifice completely. This double action actually gives you double the drainage capacity of ordinary steam traps.

MODEL 60-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400° F. Duo-Step levers and brackets of stainless steel construction. Seats and discs are of Clark-loy. ½" or ¾" horizontal inlet and outlet connections with ¼" test outlet and drain plug. Vertical inlet can be furnished in ½" or ¾" size.

MODEL 70-D traps are of cast semi-steel construction, designed for pressures up to 200 P. S. I. and temperatures to 400° F. All working parts of stainless steel construction. Seats and discs are of Clark-loy Horizontal inlet and outlet connections located at bottom of trap body for close-to-the-floor installations.

MODEL 70-TD for pressures to 150 P. S. I. and temperatures to 375° F. is available WITH BUILT-IN THERMAL BY-PASS at additional cost.

FOR COMPLETE INFORMATION CONTACT YOUR CLARK REPRESENTATIVE OR WRITE FOR *NEW* DUO-STEP BROCHURE

HOME OF DUO-STEP LEVERAGE

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Get

something extra

when you buy

lead pipe and fittings

Quantity, size, type, physical composition . . . these are what you specify when buying lead pipe and fittings.

Do one thing more, however. Specify National and get certain extras . . . extras that take full advantage of lead's ability to withstand attack by corrosives.

For one example, when you specify National "Tubond" pipe and fittings, you get the corrosion resistance of lead combined with the strength of steel, in a virtually inseparable union of lining and casing. And the lead you get is a grade that Nature endowed with excellent acid-handling qualities — St. Joe Chemical Lead. You get equipment designed to handle acids under difficult conditions of temperature, pressure and vacuum. You get full flow-way. You get greater security against leakage, because of extra lead on flange faces.

Extras in design, in fabrication, in careful chemical composition. To get them make this specification: National!

Lead pipe and fittings with a NATIONAL reputation

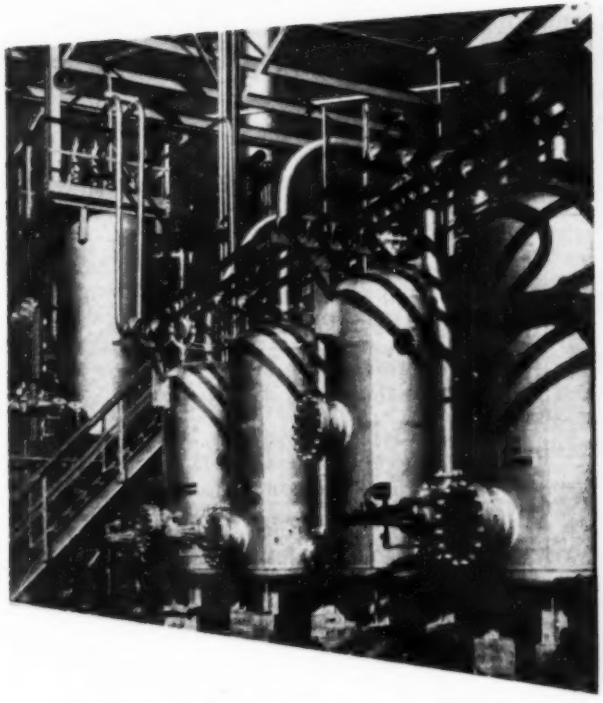
LEAD COMPANY

New York 6; Atlanta; Baltimore 3; Buffalo 3; Chicago 8; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; New England: National Lead Co. of Mass., Boston 6; Pacific Coast: Morris P. Kirk & Son, Inc., Los Angeles 23, Emeryville 8 (Calif.), Portland 10, Seattle 4; Canada: Canada Metal Co., Ltd., Toronto 8, Montreal, Winnipeg, Vancouver.

*Reg. U. S. Pat. Off.

Top Refiners demand *Top Quality Chemicals* . . .

—they specify SOLVAY



★ SODA ASH
★ CAUSTIC SODA
★ CAUSTIC POTASH
(Flake-Small Flake-Solid-Liquid)
★ CALCIUM CHLORIDE
★ SODIUM NITRITE

QUALITY—The nation's finest refiners know they can *always* count on SOLVAY for purity that never varies . . . purity that meets the highest standards. And you get SOLVAY's high quality—*at no increase in price!*

DEPENDABILITY—SOLVAY is America's leading producer of alkalies and associated chemicals—with over 70 years of know-how and the world's finest production facilities! And to assure prompt delivery of *any size order*—SOLVAY has plants and over 200 local stock points that are strategically located to serve every section of the country—*quickly and efficiently!*

SERVICE—SOLVAY's 13 branch offices with their organization of trained field representatives are staffed with men who have had many years of industry-wide experience to give you the close, personal attention that best fits your *individual needs!*

SOLVAY

Soda Ash • Snowflake® Crystals • Potassium Carbonate • Calcium Chloride
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HOW TO FIGURE THE COST OF STEAM TRAPS

STEAM TRAPS are something like wives. First, there is the cost of securing one and installing it in its new home. Then, there is the cost of maintaining it. Now, everyone knows that some wives are frugal and help their husbands a great deal, while others are frivolous spendthrifts. It is the same way with steam traps. You have to figure the original installed cost, the maintenance cost and the effect on general operation.

Divide the total expenses by life of the trap and you get down to the real heart of the matter—the *cost per year.* This is where Armstrong steam traps really shine! Let's take a look at the details:

DIRECT TRAP COSTS

1. First Cost. The price of Armstrong traps is low in terms of capacity. An optimum relationship between leverage, bucket weight, bucket travel and orifice size gives big capacity in a small package. Armstrong steam trap capacity ratings are based on *actual* tests with condensate at steam temperature and with actual hookups. They tell you what the trap will deliver *on the job.* This is not generally the case with other trap ratings.

2. Installation Cost. In four of the most widely used sizes, Armstrong traps are available in either side inlet—side outlet or bottom inlet—top outlet body styles, making possible the simplest, lowest cost installation.

3. Maintenance Cost. 40% less maintenance with Armstrong traps is the average of all the maintenance reduction reports secured from users over a period of years. This is due to high quality of parts, generous safety factors and inverted bucket know-how.

4. Repair Parts Cost. Armstrong heat treated chrome steel valve parts, precision ground and lapped, last a long time. When they do require renewal, a complete new valve mechanism right off the factory production line transforms an old trap into a new one at low cost.

INDIRECT COSTS

1. Cost of Steam Waste. This cost occurs through leaky trap valves, through traps that stick open or lose prime, through extra hours of operating heat transfer equipment due to poor drainage. This is a cost you can eliminate with Armstrongs.

2. Cost of Efficiency Losses. Poor trapping cuts heat transfer efficiency. Figure how much 10% loss affects the return on a $5000 production unit, or a $1,000,000 plant. Armstrong traps discharge condensate and air as fast as it accumulates, keep steam equipment at peak productive efficiency.

3. Cost of Downtime. Armstrong traps stay on the job long and faithfully, eliminating the production losses caused by excessive downtime for maintenance.

A steam trap casts a mighty big shadow that is multiplied by the number of traps in a plant until it has a major effect on operating costs. When you figure the costs from all angles you will find it pays to specify "traps shall be Armstrong."

FREE: **STEAM TRAP BOOK**

—44 pages of prices, design, selection, installation and maintenance data on Armstrong steam traps. You are welcome to a copy. Call your local Armstrong Representative, or write.

ARMSTRONG MACHINE WORKS

826 Maple Street • Three Rivers, Michigan

ARMSTRONG
INVERTED BUCKET
STEAM TRAP

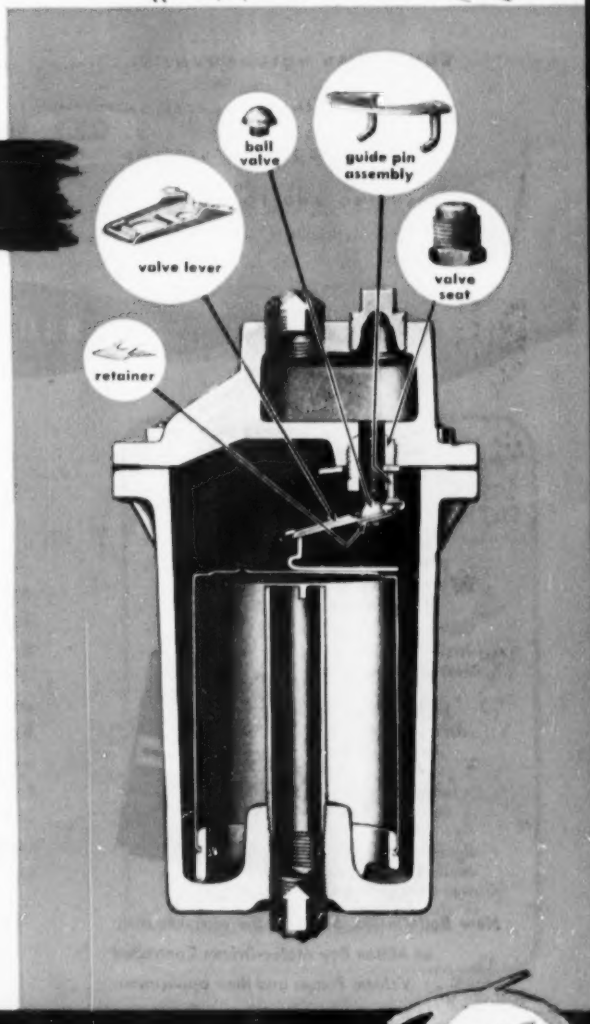
ARMSTRONG

YOU CANNOT BUY A BETTER TRAP THAN AN ARMSTRONG . . .

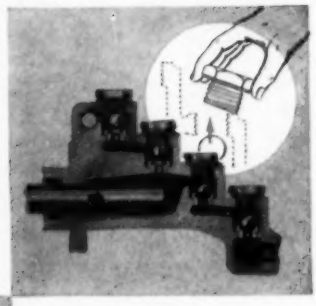
Here Are Some Questions for Cost Comparison

1. Will the valve stay steam-tight for 2 to 3, or even up to 10 years depending on the service?
2. Will the trap discharge condensate at steam temperature to keep equipment hot and minimize non-productive radiation losses?
3. Will the trap automatically discharge air in sufficient volume to keep equipment at peak temperature and to prevent corrosion?
4. Is there enough safety margin of power in the bucket and lever to open the trap when the orifice enlarges slightly due to wear?
5. Can the trap stick in open position?
6. Is the trap apt to lose prime?
7. Are the published trap capacity ratings accurate and reliable for trap selection purposes?
8. Will the trap cleanse itself of ordinary dirt and scale?
9. Is the trap easy to install, inspect and repair?
10. Is the trap unconditionally guaranteed to give complete satisfaction?

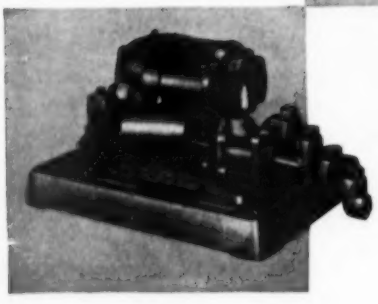
If the trap is an Armstrong, the answer to each of these questions is favorable!



STEAM TRAPS COST LESS!



Basic design simplicity of the *exclusive* Milton Roy liquid end step-valve assures high and reproducible volumetric efficiency. Inspection, servicing, or thorough cleaning of individual ball-checks and seats are effected without disturbing piping or other ball-checks and seats.



Two-to-One Service Life with this Milton Roy Pump

CONTROLLED VOLUME PUMPING
INSTRUMENTATION
PROCESS CONTROL SYSTEMS
BLENDING AND FORMULATING

ON THE JOB for a leading chemical manufacturer, this Milton Roy Motor-Driven Controlled Volume Pump is still going strong after 4½ years of operation . . . has needed very little maintenance. A previously employed chemical feed pump, on the other hand, lasted only 2½ years, and required considerable maintenance.

Long service life is just one of many reasons why rugged Milton Roy Pumps are in wide use throughout industry. Wherever requirements call for precise metering of measured quantities of liquid in controlled volume, there's one of these versatile instruments to do the job. Capacity of each pump is variable from 0 to 100% by any one of several mechanical or automatic means of plunger stroke or speed adjustment.

Driven by motor, or powered by air, Milton Roy Pumps meter practically any liquid . . . in capacities from 3 milliliters per *hour* to 45 gallons per *minute*, against pressures up to 25,000 pounds per square inch. They are available as single or multiple units or as component parts of complete chemical feed and control systems. We invite your inquiries.

***New Bulletin No. 553** tells the complete story on Milton Roy Motor-Driven Controlled Volume Pumps and their application. Write for your **free** copy.*

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

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NEW

Ratographic* MINIATURE RECORDER

Handles 4 *separate signals*

Wider application of miniature instrumentation to your own needs is now possible with the new Fischer & Porter Ratographic miniature recorder. Fitting a panel area only six inches square, the instrument *records* two variables and *indicates* two variables—OR—*records* three variables and *indicates* a fourth. It combines the same dependability, stability and accuracy which characterize *all* Fischer & Porter instruments, large and small. Check the many advantages of this instrument as listed here, then write for further information. Fischer & Porter is always ready to supply engineering assistance on *your complete process instrumentation.*

for recording...

- four simple and dependable capsule receivers
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- outside dimension 6" square
- convenient daily chart tears off without chart waste

for controlling... with **F&P** point of measurement controller mounted as illustrated, unit offers:

- record of both uncontrolled and controlled variables, with indication of valve and set point signals.
- large, easy to adjust external transfer valve and set point knobs

Glass door: no warping, scratching, or crazing. Recording, indicating and controlling functions continue to operate when chassis is extended from front of panel.

complete process instrumentation

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Marley Application Engineers enjoy the dual satisfaction of representing the world's largest manufacturer of water cooling towers and conserving one of the nation's most vital resources — water.

These Marley-trained specialists assist in water conservation by providing industry with Marley cooling towers that save 95% of the water used in wasteful process cooling methods. They have the facts and figures to prove that water conservation pays handsomely today — and will pay extra dividends tomorrow when shortage of water will be more critical. They encourage companies to introduce water conservation practices that make it possible to locate industrial plants virtually anywhere.

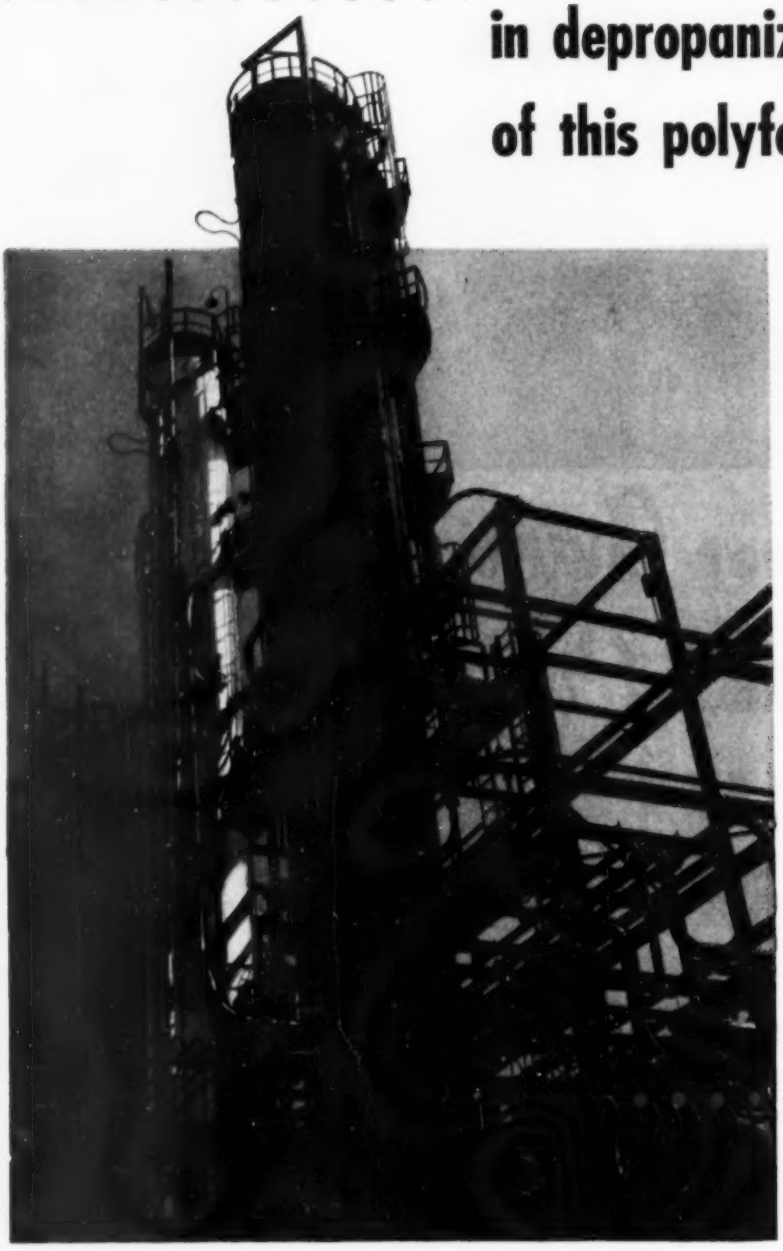
Marley Application Engineers render expert assistance in evaluating the relative merits of *all* types of towers, for Marley builds all types. This service, invaluable to owners and operators alike, is yours without obligation. Use it freely. A staff of 150 Marley engineers in 50 cities stands ready now to show you how to save water — and save money.

MARLEY

The Marley Company

KANSAS CITY 5, MISSOURI

Stainless Steel cuts tray plate cleaning in depropanizing tower of this polyform unit



HERE'S an example of the way Stainless Steel's corrosion resistance can stretch out the intervals between cleaning when used in refinery equipment.

Stainless Steel is now being used in the perforated tray plates in the depropanizing tower of the polyform unit at Gulf Oil Corporation's Port Arthur, Tex., refinery. The material formerly used for this purpose reacted with corrosive agents in the gas and the $^{3}/_{32}$" or $^{7}/_{64}$" perforations in the tray were plugged up after two to three months' use.

Then Stainless Steel was given the job. It has greater resistance to corrosion and, consequently, the intervals between cleanings are substantially longer.

Corrosion resistance is only one of the characteristics of Stainless that make it so suitable for refinery use. It is strong, its surface is dense and durable and it performs well in elevated temperature service. When you put all these advantages together, you can see why it is the most effective weapon against refinery down time.

For finest performance from Stainless equipment, always be sure that your equipment fabricator uses perfected, service-tested U·S·S Stainless Steel.

Depropanizing tower in the polyform unit at Gulf Oil Corporation's Port Arthur, Tex., plant. Stainless Steel, used in the perforated trays, has helped to lengthen the intervals between cleanings.

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NATIONAL TUBE DIVISION, PITTSBURGH · TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
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UNITED STATES STEEL

How a military aircraft problem led to

The Greatest Gasoline Development in 31 Years

TCP* is a revolutionary new gasoline additive that stops the greatest cause of power loss in modern automobile engines. TCP additive is now blended into Shell Premium, and is available at Shell stations throughout the United States.

With the advent of high octane number fuels for peak performance of both military and civil aircraft, the problem of spark plug fouling became critical. Maximum design performance and range of the aircraft were severely limited by deposits formed on the insulating portions of the spark plugs. These deposits caused malfunctioning of the spark plug often at critical times when maximum spark plug performance was necessary. The problem was studied jointly by petroleum suppliers, engine and spark plug manufacturers, and airframe builders both from the chemical and mechanical standpoint.

Shell Research Mobilized

To tackle the problem Shell mobilized its research facilities. First step was development of a dependable test for spark plug fouling. With this test, Shell had the necessary equipment with which hundreds of compounds could be quickly tested—rejected and tested again in different formulations. Round-the-clock testing finally led to the discovery of Shell's TCP additive.

Not since the introduction of tetraethyl lead in 1922 has there been such an important development in gasoline.

How TCP additive helps existing engines—can lead to even better designs

This remarkable ingredient actually changes the nature of combustion deposits inside an engine; actually makes them harmless. Plug-shorting and pre-ignition are eliminated. Now car owners get up to 15% more power—often before using the second tankful. Spark plug life is increased as much as 150%, and gasoline mileage is improved.

Car manufacturers and dealers benefit too! New cars perform the way designers intended; new car buyers have few performance complaints. And for the future, designers can plan for higher compression and horsepower, lighter and more compact engine designs.

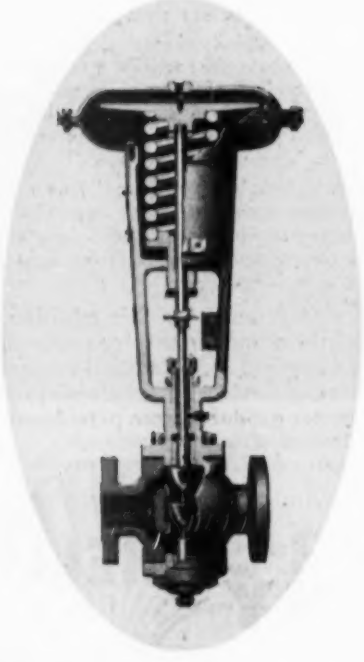
TCP is Shell's trademark for this additive. It is another example of the progressive research that goes forward day and night in Shell laboratories. It is evidence again that Shell research provides more and better products from petroleum.

*Patent applied for

SHELL OIL COMPANY

Meet the modern valve for modern process control

the new Honeywell Series 800



Look at these features:

- **SMALL AIR CHAMBER . . .**
  minimum volume of dead air assures fast response to control air signals.
- **TIGHTLY SEALED DIAPHRAGM . . .**
  extra thick, molded-in gasket around bolt circle prevents air leaks; reinforced construction gives high flexibility, long life.
- **STAY-TIGHT STEM LOCK . . .**
  won't separate under most severe vibration.
- **STURDY, ATTRACTIVE YOKE . . .**
  no useless weight, but plenty of strength; stands roughest handling. Pads on both sides of yoke facilitate mounting of auxiliary equipment.
- **CHOICE OF BONNET DESIGN . . .**
  screwed or bolted.
- **PACKING . . .**
  graphite-impregnated asbestos or shredded Teflon.

New Solid V-ported Disc for high-velocity service

Now available with the Series 800 double seated line is this solid equal percentage disc. It's especially applicable to high velocities and high pressure drops; has better stability and resistance to erosion; minimizes noise. Rangeability up to 50 to 1.

Here's the new look—coupled with new performance standards—in diaphragm motor valves. The Honeywell Series 800 incorporates every feature of design that is demanded by the process control applications of today . . . and of tomorrow, too. In response . . . sensitivity . . . reproducibility . . . overall performance . . . the Series 800 valve is the ideal partner of advanced instrumentation. It's available in a full range of styles and sizes. Get complete technical data today, by writing for Bulletin 800.

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VALVE PRODUCTS
First in Controls

Deaerating Heaters

BY WEIGHT? OR BY DESIGN?

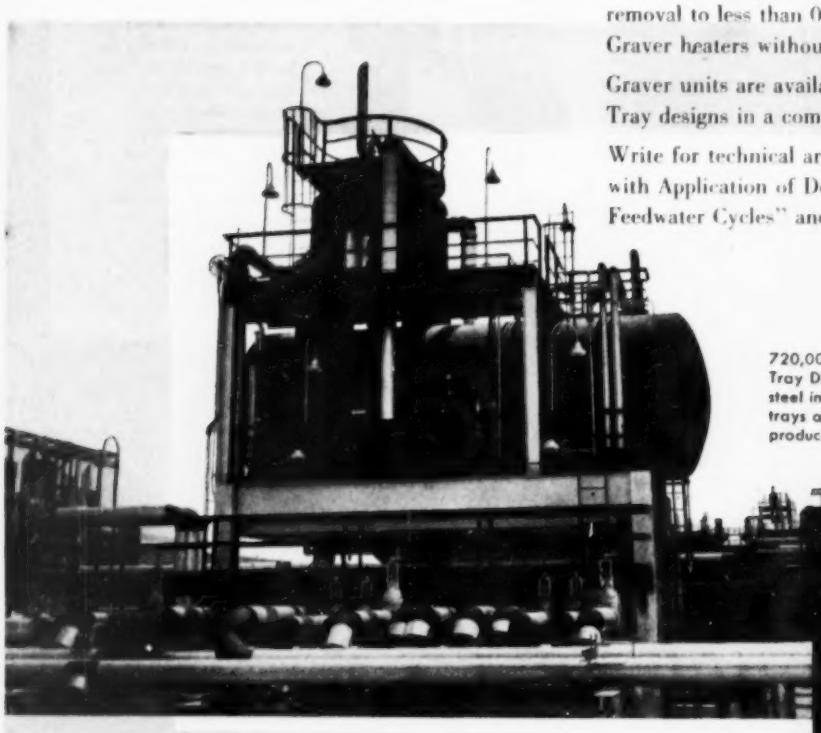
Forty-five years ago, deaerating heaters were built of cast iron trays and outer shells. Cast iron was corrosion resistant, but was also heavy and cumbersome.

Today, Graver's effective design has eliminated the need for this excessive weight. Yet, Graver Deaerating Heaters are corrosion resistant and structurally strong. *Stainless steel* is used for all internal parts in contact with corrosive water or atmosphere as well as for internal vent condenser, trays and trim. All other parts of the vessel are constructed of high grade carbon steel.

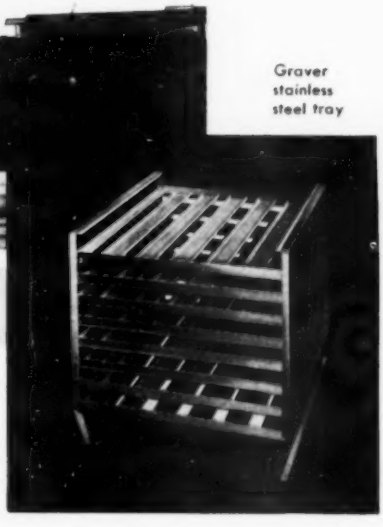
Furthermore, although the weight of Graver Deaerating Heaters has decreased over the years, the efficiency in oxygen removal has increased. Oxygen removal to less than 0.005 ml / liter is obtained in Graver heaters without difficulty.

Graver units are available in Spray, Tray, and Spray-Tray designs in a complete range of sizes.

Write for technical article, "Experiences with Application of Deaerating Heaters in Feedwater Cycles" and bulletins.



720,000 lb. per hr. Graver Spray-Tray Deaerating Heater with stainless steel internal vent condenser and trays at a southwestern metal-producing plant.



Graver stainless steel tray

GRAVER WATER CONDITIONING COMPANY

Division of Graver Tank & Mfg. Co., Inc.

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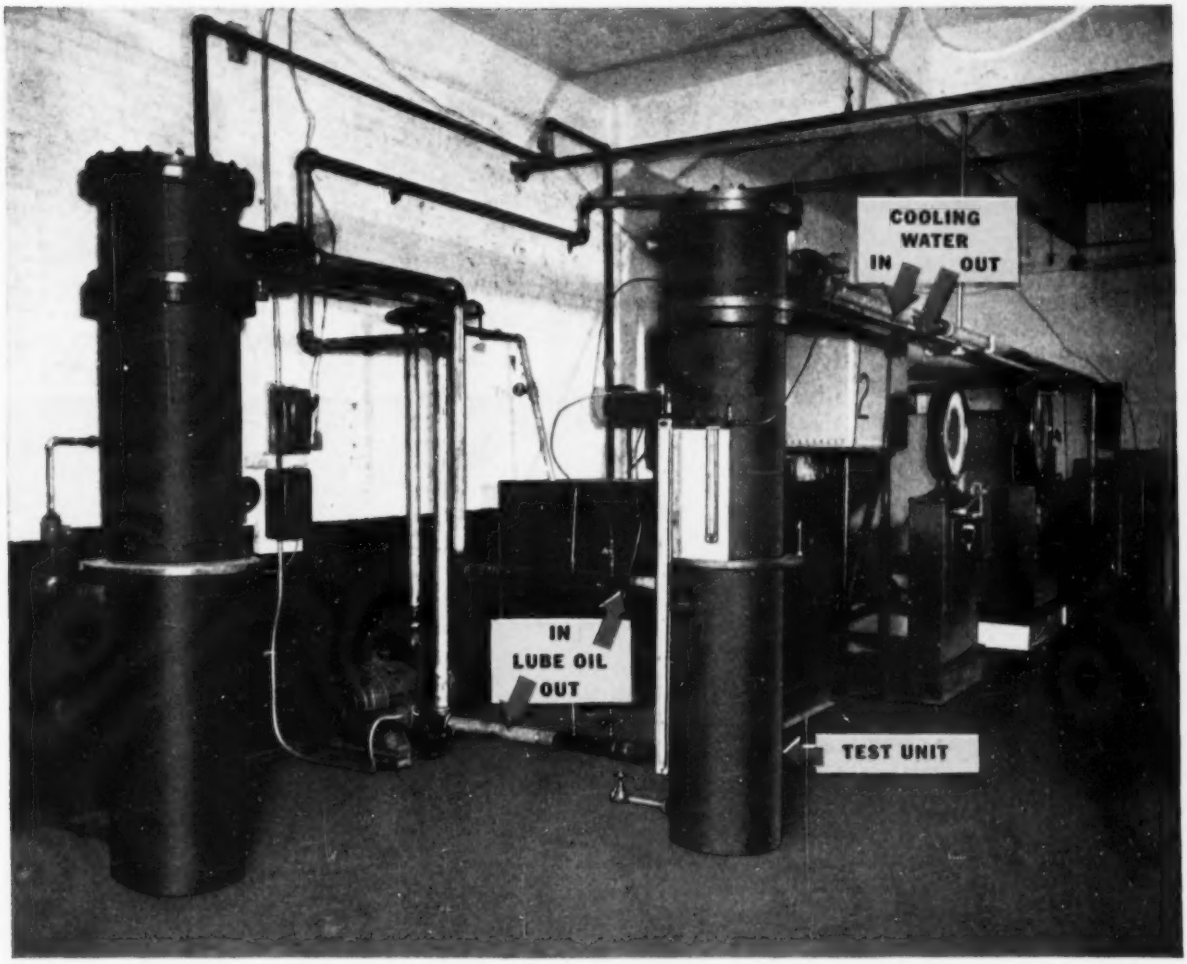
GRAVER EQUIPMENT FOR ALL WATER AND WASTE TREATMENT PROCESSES

Deaerating Heaters

GW482



PERFORMANCE-TESTING ADSCO LUBE OIL COOLERS

Here's a picture with a big story! It shows performance tests being run on one of a large group of ADSCO Lube Oil Coolers.

These tests prove conclusively that everything claimed for these coolers will be performed by them when installed...because the tests are conducted under actual operating conditions in ADSCO's testing laboratories. And here's how the tests are run: Before the lube oil enters cooler at 130 g.p.m., it is brought up to specified temperature of 150F by unit at left and then cooled to 130F by 250 g.p.m. of water entering cooler at 115F and leaving at 119F. Inlet and outlet temperatures are checked by thermometers. Pressure drops for both shell side and tube side are determined by manometers. Oil and water are collected in reservoirs and weighed in tanks on scales to determine capacities.

This testing service puts a pedigree on ADSCO Heat Exchangers. These units, engineered and tailor-made to requirements, come to you exactly rated when tested by ADSCO. The exchanger can be put in the line with complete assurance it will do the job.

ADSCO ENGINEERED PRODUCTS

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NORTH TONAWANDA, NEW YORK

Since 1877

(To obtain more data on advertised products see page 1936)

Building a new Ethylene Plant

Shown here in its final stages of construction, National Petro-Chemicals Corporation's new ethylene plant at Tuscola, Illinois is the largest in the world—the tenth ethylene plant which Lummus has designed and built.

Perhaps our experience in designing, engineering and building petrochemical and chemical plants can be of use on your next project.

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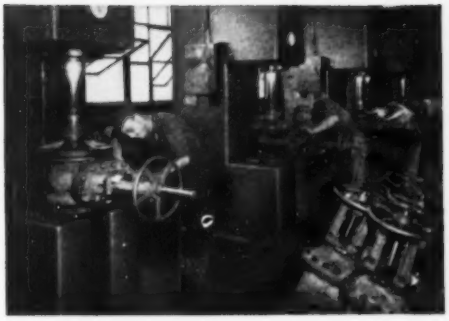
DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES



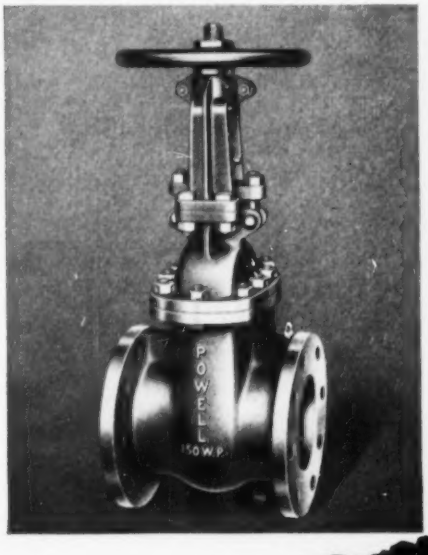
The Finishing Touch

Small details can make a big difference in trimming a tree . . . and in manufacturing valves. For example, *every* Powell Valve part must pass *rigid inspection.* Then, as a final, finishing touch, each Powell Valve is subjected to *actual line tests.*

It's these seemingly small details that have helped Powell Valves maintain their record of dependability since 1846. Powell has probably done more valve research, solved more valve problems, and makes more types of valves than any other organization in the world.

With Powell Valves on the job in your plant, you'll say every day's a holiday from flow control worries. Following are just a few of the valves that have the gift of dependable service you want—and need. They're available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.

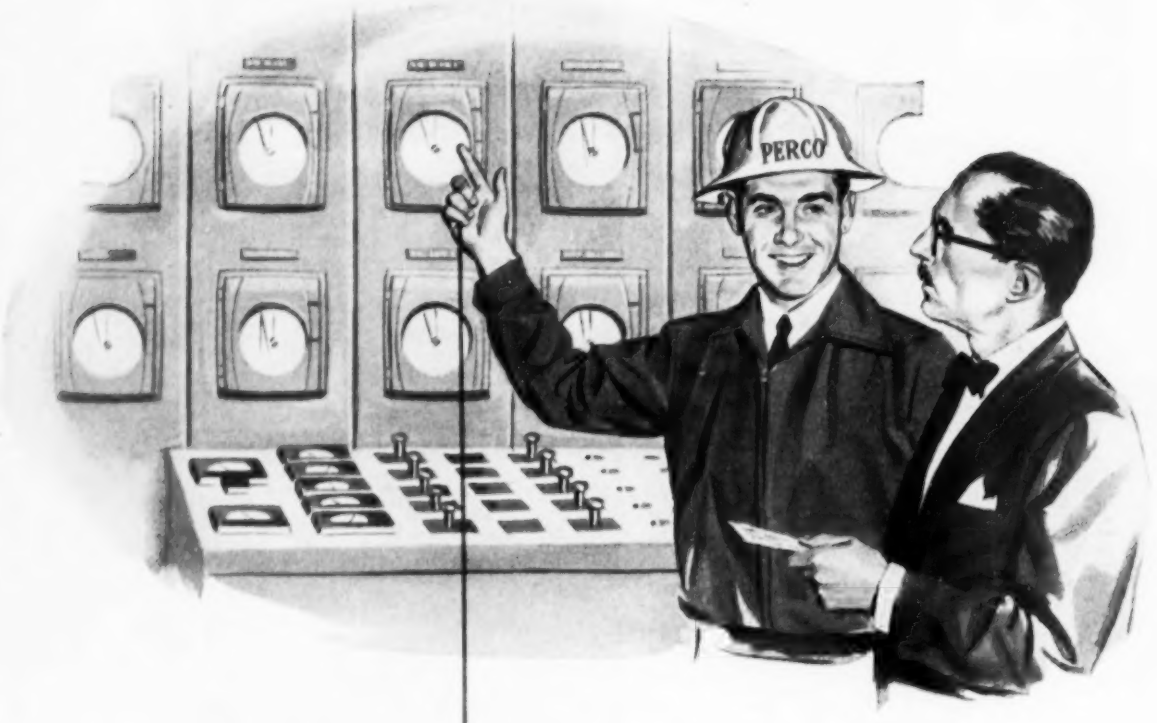
STAINLESS STEEL O.S. & Y. GATE VALVE *(Fig. 2453-G)* for 150 pounds W.P. at 500 F. Interchangeable solid or split wedges are precision fitted and accurately guided throughout entire travel. Sizes 2½" to 4", one-piece yoke: 5" to 30", separable yoke arms.



LUBRICATED PLUG VALVE *(Fig. 2201).* Quarter turn of tapered plug opens and closes valve. Lubricant grooves surrounding parts provide positive seal. Seating surfaces not exposed when open. Semi-steel, 175 and 200 pounds W.O.G.; carbon steel, A.S.A. 150 and A.S.A. 300 pounds.

BRONZE "W.S." FULL FLOW GLOBE VALVE *(Fig. 2608)* for 200 W.P. Stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow with pressure drop and turbulence cut to minimum.

P V



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Bartlesville, Oklahoma

The second of two articles on profits

What Are PROFITS Used For?

This is the second article on the role of profits in our economy. The first was addressed to the question: "How High are Profits?" The answer was found to be: not high when compared with previous years and the present investment in corporate facilities. This second article is addressed to the equally important question: "What do corporations do with their profits?"

In 1953 corporations will earn about $20 billion *after taxes*, if the recent rate of earnings is maintained throughout the year. These profits will be used (1) to expand and improve productive capacity through purchases of new plant and equipment, (2) to finance the operations involved in a growing volume of business and (3) to reward the people who have invested their money in American industry. Of the $20 billion, the corporations will pay about $9 billion to their stockholders as dividends. They will use the $11 billion that remains to purchase new plant and equipment and to increase their working capital.

This year corporations are increasing their plant, equipment and working capital by a total of approximately $32 billion. Of this amount, about $26 billion is for new plant and equipment. The remainder is for working capital. As this article will show in greater detail, about $21 billion of this will come from depreciation allowances and sales of new securities. The other $11 billion will come from retained profits.

It is impossible to trace exactly how each dollar of retained profits is spent. This money is mixed with other money that goes into the company treasury in the form of proceeds from loans, sale of securities and depreciation allowances. *However, it is a fact that by retaining $11 billion of their profits this year, corporations have provided $11 billion toward their total capital requirements, including the money needed for expanded and improved capital equipment.*

Profits Mean New Plants

This year American industry is engaged in a very large expansion of plant facilities. This will increase the industrial capacity of the nation by about 7 per cent. Since 1950, our capacity has been increased by about 12.5 per cent. And all of this expansion has been privately financed, even though about one-third of it was certified as necessary for national defense.

The expenditure during 1953 of $26

billion for new plant and equipment—an alltime record—imposes terrific financial responsibilities on our corporations. About one-half of the amount required will come from depreciation allowances. In general, these allowances are supposed to pay for the replacement of worn-out or obsolete equipment. Another $8 billion will be raised by corporations through new security issues and long-term mortgage loans. All together, depreciation allowances, security issues and long-term loans will provide about $21 billion. But this is still $5 billion short of the $26 billion needed for new plant and equipment this year. Thus, it is retained profits that spell the difference between expansion and standing still, between growth in the productive capacity of the economy and running downhill.

As plant facilities are expanded, corporations also need more working capital. A larger volume of business requires larger inventories, larger accounts receivable and larger amounts of ready cash to meet payrolls and bills for materials. The increase in these items during 1953 is estimated at $8.5 billion, of which about $2.5 billion will be supplied by short-term bank loans. The other $6 billion will come from retained profits. Thus, retained profits provide an essential $11 billion—$6 billion for working capital, $5 billion for new plant and equipment—to meet corporate financial requirements.

Incentive for Investment

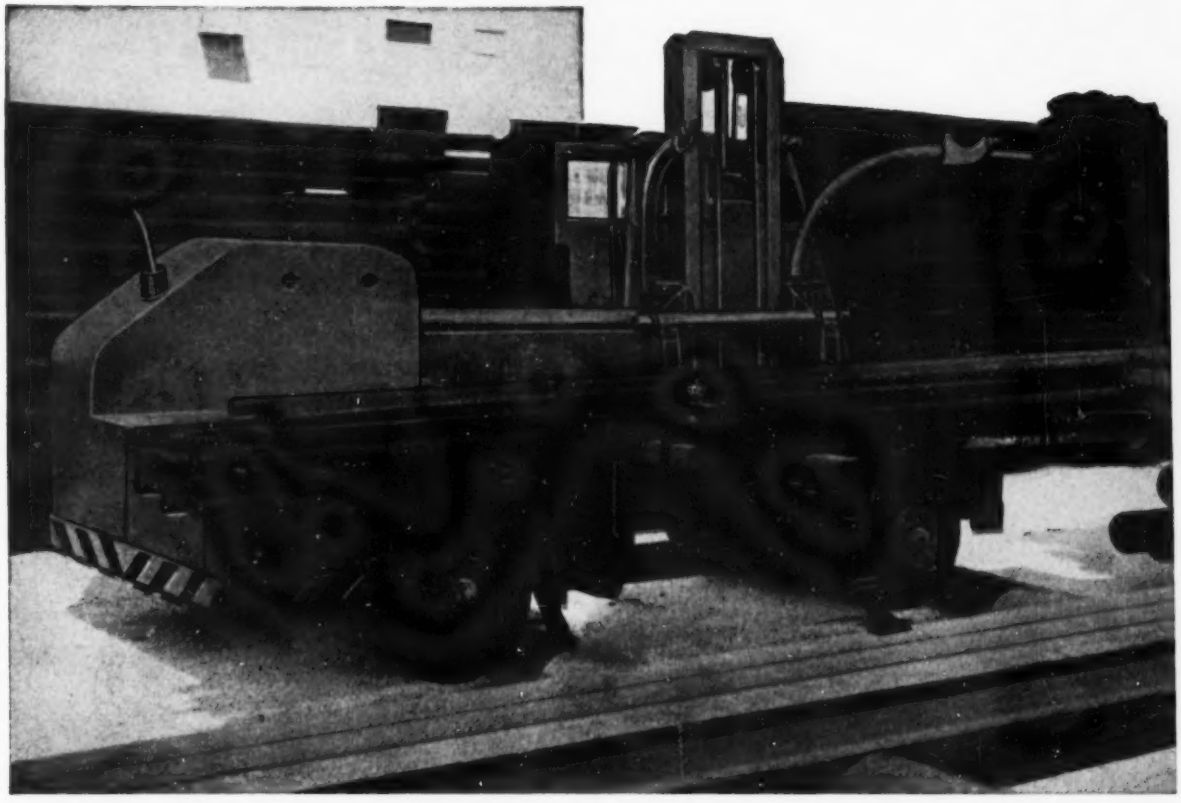
The role of the profits that are paid to stockholders as dividends or to employees under profit-sharing plans is even more important than the role played by retained profits in providing plant, equipment and working capital. Dividend payments provide the main incentive for investment in the stocks of corporations. They are the reward for risks taken by investors. Dividends paid by corporations whose common stocks are listed on the New York Stock Exchange provide an average return of about 6.5% at present prices, and dividends on preferred stocks average about 4.5% return. Dividends are distributed among 6.5 million stockholders. Also, it is estimated that 3 million employees now are covered by profit-sharing plans. These plans increase the incentives of both production workers and managers to work harder and more efficiently.

Thus, more than 9 million Americans have a *direct* financial stake in corporate profits through ownership of stock or participation in profit-sharing plans. But *all* Americans share indirectly in the rewards of a successful business year. Investment of a major part of 1953 profits in new plants and equipment means more employment opportunities and better working conditions for labor. For the nation, it means new industrial capacity that is essential both for national defense and to produce more and better goods for a rising standard of living.

Corporate profits after taxes represent about 6% of the nation's total income. But the job they do to stimulate investment and to finance industrial expansion and improvement is more far-reaching and more essential to the prosperity and well-being of the American people than would be suggested by that small figure.

McGraw-Hill Publishing Company, Inc.

How ESSO STANDARD OIL CO. Speeds Materials Handling



Side-loading Traveloader® Sets New Standards for Speed and Efficiency

Esso Standard Oil Company uses three model T10-G2 Traveloaders continuously in their materials storage yard at Baton Rouge, Louisiana. The Baton Rouge yard has a high turnover of materials including pipes, rails, lumber and many other hard-to-handle items of equipment. Three men each operating Traveloaders can move, stack, and deliver this material with a minimum of assistance from others. This is typical of what Traveloader is accomplishing for hundreds of satisfied users and of what it can do for you. Traveloader operates in a straight line, parallel to its load, in aisles no wider than 10′ thereby increasing the storage capacity of a given area up to 50%.

A Wide Variety of Attachments gives Traveloader versatility, flexibility and utility beyond the range of any other materials handling equipment. Traveloader can be used to replace a yard crane, strip steel carrier, multiple pallet mover, fork lift truck and transporter.

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Write today and let us send you Bulletin AD-30A containing full details and specifications on this remarkable machine.

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The Baker-Lull Corporation • Subsidiary, Minneapolis, Minn.
Material Handling and Construction Equipment

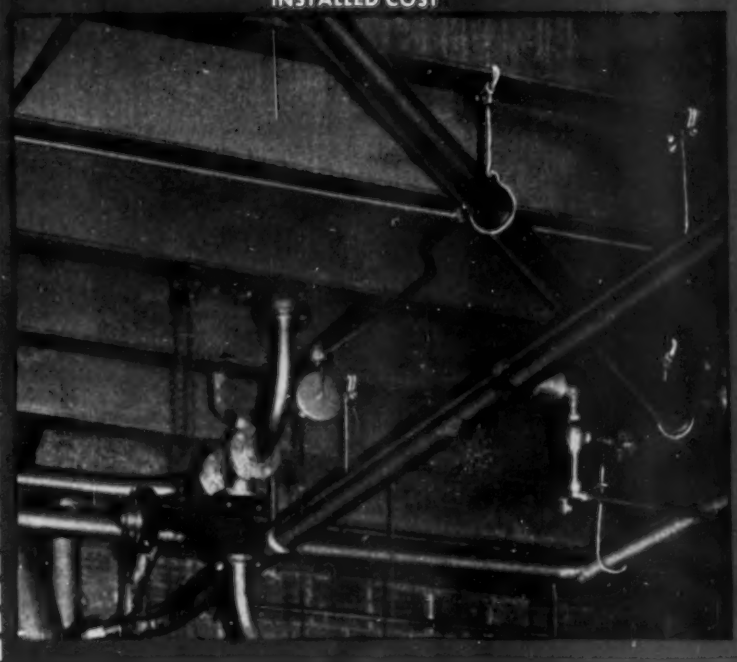
take a closer look at

Light-Weight STAINLESS PIPING

Schedule 5 and Schedule 10

INITIAL COST

INSTALLED COST

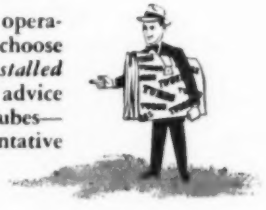


The *initial*-cost economy of Schedule 5 and Schedule 10 stainless pipe is always attractive but only pays dividends to the careful buyer. He is willing to remember that light-weight pipe frequently requires added supports or hangers and always requires special fittings. He also remembers that alignment problems may require a longer installation time. Therefore, he balances the attractive *initial* cost against *installed* cost.

The buyer also thinks of the adaptability of new piping to existing lines and possible future requirements such as increased operating pressures.

B&W manufactures all the standard pipe size schedules in a complete range of stainless steel grades. Thus, a buyer can obtain stainless pipe to meet any and every individual requirement.

It will pay you to analyze your operating requirements carefully and choose your stainless pipe on the basis of *installed cost* rather than *initial cost*. For any advice on stainless pipe or tubing, Mr. Tubes—your impartial B&W Tube Representative—is always on call.



THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing

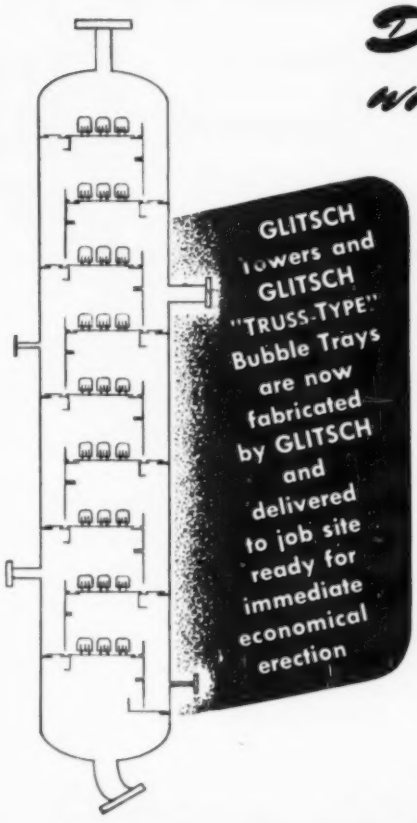
B&W SEAMLESS and WELDED TUBES

TA-1761 (G)

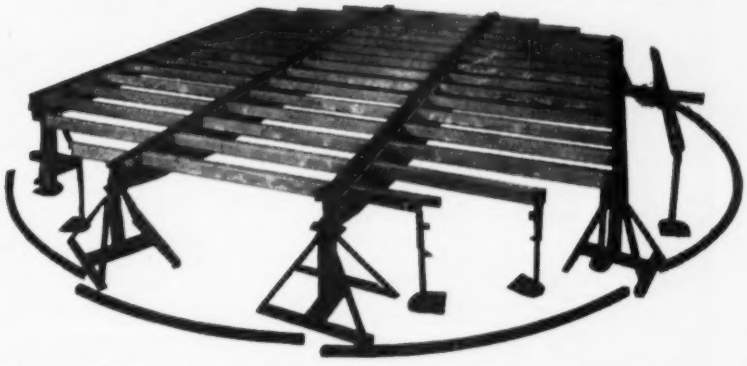
279 designs

Glitsch Has Dies for 279 Cap and Riser Assemblies for Specific Requirements

Existing dies of 279 different cap and riser designs are available for process recommendations as well as data on the various ratios of related areas. Customers' engineering staffs have found GLITSCH'S experience relative to this wide range of assemblies an added value in planning stages. Practical ideas for improvements in the constantly changing petroleum refining and chemical processing industries are a part of GLITSCH service in their world-wide operations.


GLITSCH towers and GLITSCH "TRUSS-TYPE" Bubble Trays are now fabricated by GLITSCH and delivered to job site ready for immediate economical erection

Design your process requirements with complete freedom of design



The GLITSCH design offers its outstanding, flexible features and mechanical supporting structure to the refining and chemical processing industries. The process engineer has complete freedom to design accurately the most efficient bubble tray for each of his process problems.

GLITSCH trays are doing a top notch job in all types of fractionation and distillation equipment such as vacuum, crude, light ends and petrochemical units. GLITSCH *"TRUSS-TYPE"* light weight bubble trays are custom-built from the corrosion resistant materials best suited to the individual needs of each fractionation job.

Glitsch "TRUSS-TYPE" Bubble Trays, Towers and other Petroleum Refinery, Chemical and Industrial Equipment

Glitsch
FRITZ W. GLITSCH & SONS, INC.
P. O. Box 6227
DALLAS 2, TEXAS

SALES OFFICES:
NEW YORK CHICAGO
CLEVELAND TULSA
HOUSTON LOS ANGELES

SOHIO

MCC

TEXACO
REG TM

AMERICAN
Cyanamid
COMPANY

This Westinghouse high-voltage switchgear automatically and rapidly clears trouble at Standard Oil's Lima Refinery. If there's a momentary outage, the load is reapplied in segments.

Westinghouse control centers minimize maintenance problems and give Mississippi Chemical the advantages of grouped control. Individual units can be installed or removed with file-drawer efficiency.

Petroleum and chemical companies confirm:

Westinghouse equipment provides dependability

Our engineers help you get dependability by combining Westinghouse electrical equipment with creative system planning. Here's proof.

Sohio's Lima Refinery got power dependability without paying extra for stand-by capacity. Westinghouse engineers helped develop a power system which provides a fast restoration of service after interruptions. Westinghouse supplied a control system that automatically and rapidly clears trouble. This system successfully handled twelve power interruptions during the first nine months of operation, without loss of refinery production.

Mississippi Chemical officials called on Westinghouse to help them get a complete "packaged installation" with the best electrical equipment at no extra cost. One feature was that Westinghouse control centers were installed in nonhazardous locations throughout the plant. This gave Mississippi Chemical the advantages of centralized control without paying for more expensive explosion-proof equipment.

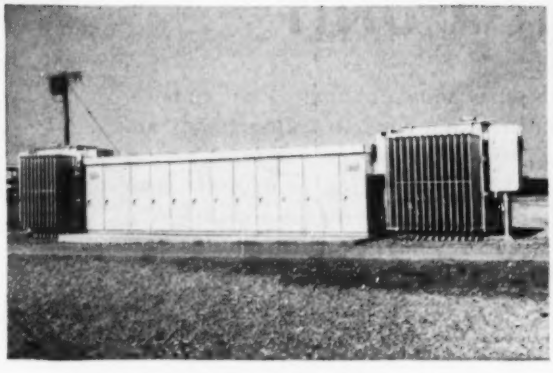
Texaco's Eagle Point Refinery got top-system dependability, efficiency and flexibility for future expansion. Westinghouse turbine-generators supply all the power, but there's also a tie-in with the local utility for emergency purposes. Dual-feeder cables carry power to all Westinghouse outdoor load centers. If one faults, the other can handle the full load. All Eagle Point has to do for any plant expansion is add substation capacity.

American Cyanamid and Westinghouse engineers worked out a power distribution system that prevents outages. If there's trouble on any feeder, power is switched to another. If a substation faults, other substations carry the load through cross connections. This system can be easily and inexpensively expanded as the plant grows.

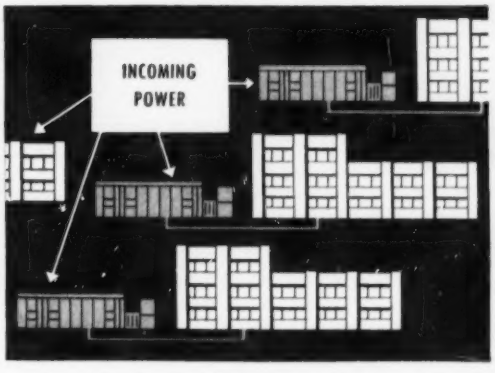
These solutions are only four examples of how Westinghouse equipment and services can meet your power distribution problems. If you'd like more information on the above, or other installations, call your Westinghouse representative. Or write to: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-94992

YOU CAN BE SURE...IF IT'S Westinghouse

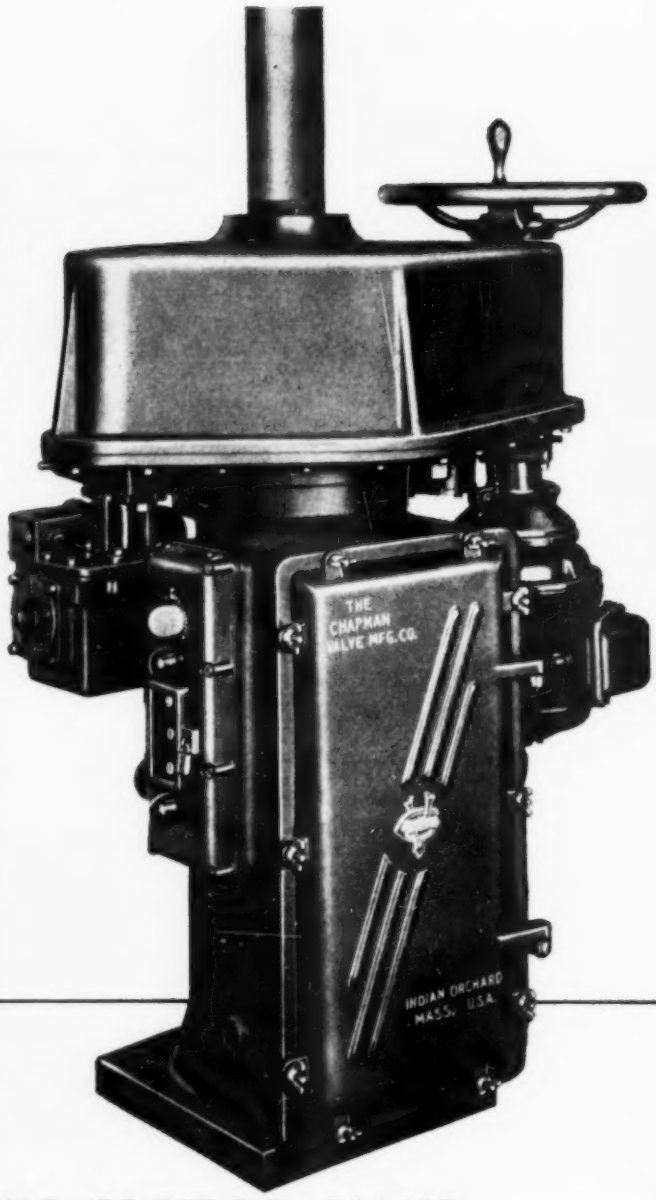


Eagle Point Refinery's Westinghouse substations are complete with switchgear, transformers and circuit breakers in one, compact arrangement. The system is highly flexible and dependable.



American Cyanamid spotted 10 substations throughout the processing area. When new buildings are added, additional substations will be installed without interfering with production

SMART OPERATOR for Valves, Gates and Floorstands



CHAPMAN'S MOTOR UNIT

Instant control of valves and large sluice gates at the touch of a button . . . that's what you get with Chapman Motor Units on the job. Completely housed and thoroughly dust and weather proof, these units are built "to take it" for years, on the roughest service. They're designed for simplicity and extreme ruggedness, as shown by internal view above.

Chapman Motor Operated Floorstands are delivered to the job with all internal wiring complete, so all the wiring to be done is to bring the power leads into the connection box... saving time and money in installation and assuring proper operation. Write for Catalog No. 50.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

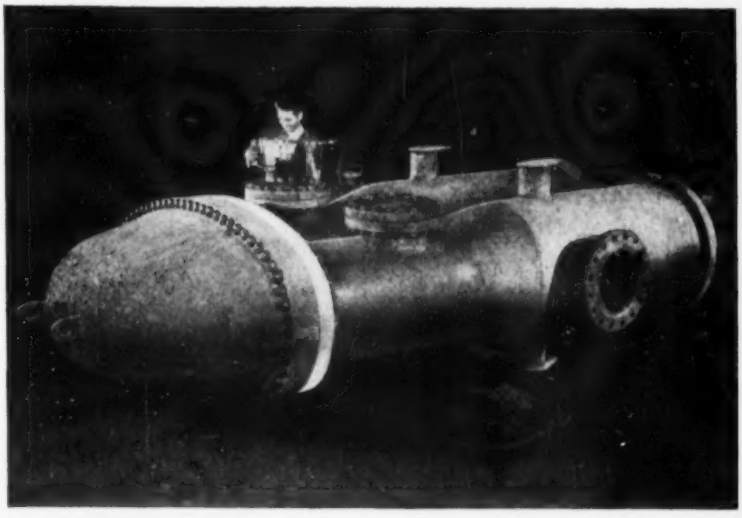
PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY DECEMBER 1953

Unique Bundle Puller Makes Gains Abroad

Kellogg's Hydro-Ejector, a special device for hydraulically removing and retracting tube bundles, is now standard equipment in many refineries. The use in the United States has generated considerable interest abroad, and independents as well as U. S. affiliates are using this portable unit to speed maintenance work.

Experience has proved that two men can handle even the largest bundles, taking less than 25 minutes to perform the operation of ejecting or retracting any size unit a distance of eight feet. The Hydro-Ejector can exert a force of 12,000 pounds, sufficient to overcome dirt formations that cause many bundles to stick.



Special High-Temperature Exchangers for Gasoline-from-Coal Synthesis

Illustrated is one of ten unique heat exchangers especially designed and fabricated by Kellogg for use in a gasoline-from-coal synthesis plant under construction in South Africa. This exchanger is being made ready for hydrostatic testing.

When in service the units will perform a highly critical function in the pre-heating of gas in a catalytic reforming unit. Each capable of operating under temperatures of 1625°F and pressures of 365 psi, the exchangers are being fabricated in Kellogg's shops rather than overseas because of Kellogg's extensive engineering and fabrication experience in production of alloy equipment for handling critically high temperatures and pressures.

Tubes and tube sheets of the exchangers are fabricated of Type 310 stainless steel. The shells are internally insulated.

In the reforming unit, residual hydrocarbons in synthesis gas, produced in the coal gasification plant, and recycle gas from the synthesis section are converted to additional synthesis gas.

High-Pressure Units Scheduled for Chemical Plant

Four special high-pressure exchangers for a major chemical processor are now being designed in Kellogg's heat transfer division.

They are of the integral tube sheet-channel type because of the operating pressures which will be in the neighborhood of 1000 psi on the tube side. Each will contain a U-tube bundle consisting of 32-foot long copper tubes.

For further information, details of methods, etc. contact

FABRICATED PRODUCTS DIVISION THE M. W. KELLOGG COMPANY

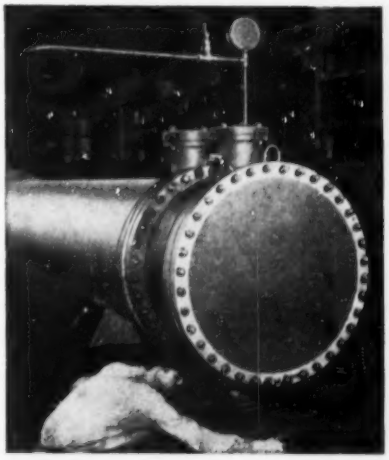
225 Broadway, New York 7, N. Y.
or offices in Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London & Paris

KELLOGG PULLMAN

Reflux Exchanger for Combination Unit

This reflux-crude exchanger is one of many exchangers, coolers and condensers recently completed in the shops for a combination refinery in Brazil. Here it is shown undergoing hydrostatic testing.

The unit is 35" inside diameter, of steel construction throughout, using ¾"OD tubes on square spacing. When installed the unit will preheat crude against reflux gas oil raising its temperature from 60° to 280°F.

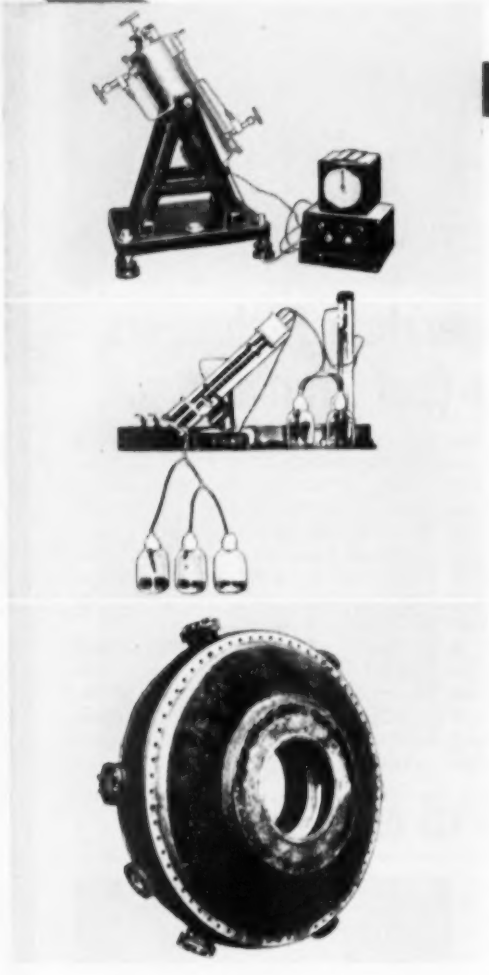


EXCHANGERS
THIN WALL ALLOY PIPING
LAD STEEL VESSELS
CONDENSERS
FRACTIONATING TOWERS
PRESSURE PIPING
DIGESTORS
COOLERS

From Crude—to Plasma—to MSG

Carpenter Stainless Tubing

Passes All Tests



In the column at the left you see pictured a high pressure Viscosimeter used for field testing in the petroleum industry; a Blood Plasma Sterilizer that speeds processing of that vital fluid; a Calandria used to extract highly corrosive Glutamic Acid in process of making Monosodium Glutamate to add savor to food.

These pieces of equipment have one thing in common—Carpenter Stainless Tubing—and for each one Carpenter tubing was specified for a *different set* of reasons. They included extra smoothness of I.D. and O.D., unusual concentricity, close adherence to published tolerances, good ductility, ease of working and corrosion resistance. One reason, however, was common to all specifications—*unvarying quality*—from piece to piece, order to order.

In short, the manufacturers of these and many other diverse types of processing equipment know that there *is* a difference in stainless tubing—and Carpenter makes that difference. Why not get the cost-saving advantages of Carpenter's all-round service satisfaction the next time you need stainless tubing?

Call your nearest Carpenter representative for prompt service on your requirements *plus* help in solving design, engineering or fabricating problems.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Branch Offices: Atlanta Chicago Pittsburgh Houston Newark San Francisco

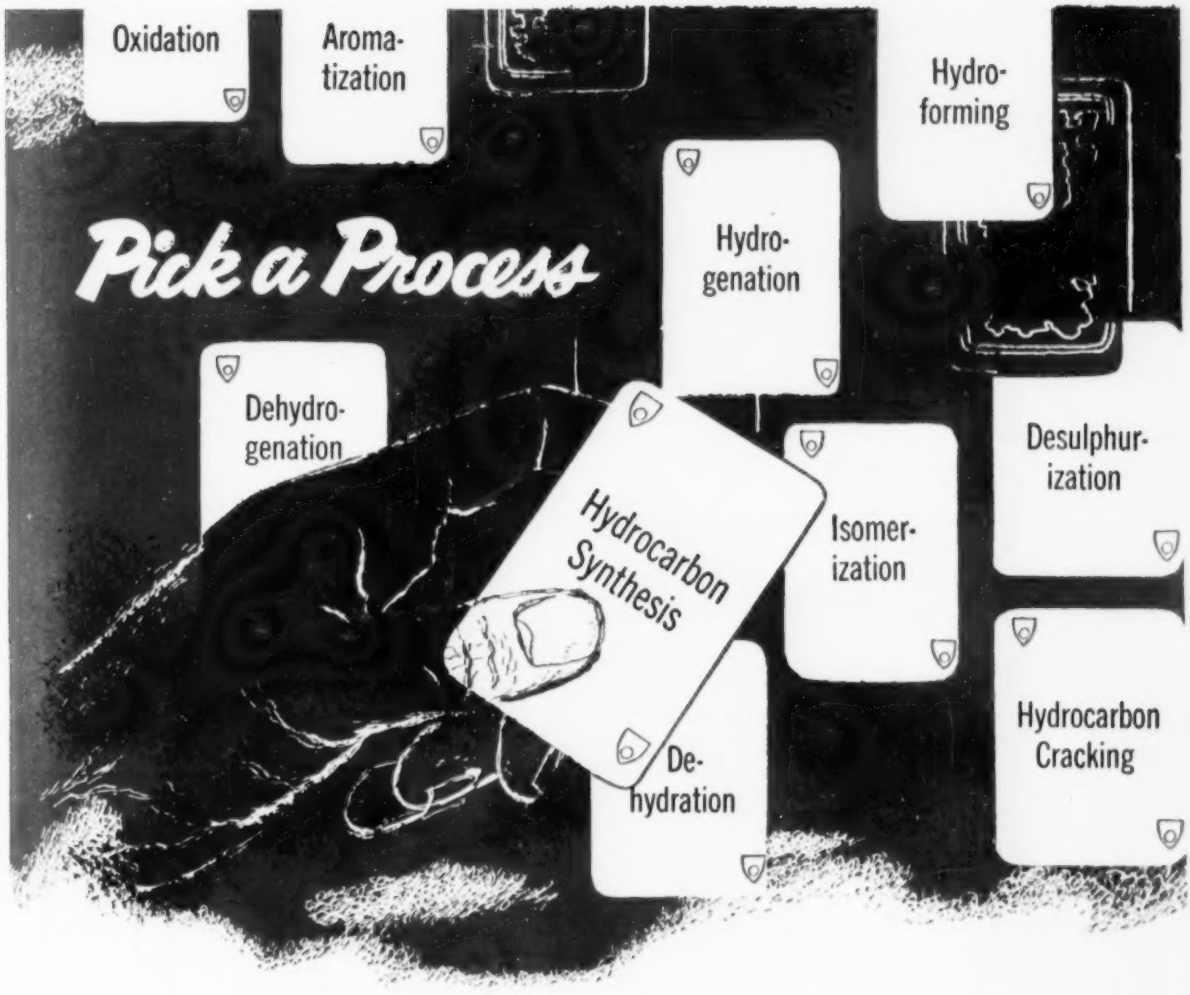
Export Dept.: The Carpenter Steel Co., Port Washington, N.Y. "CARSTEELCO"

Carpenter

STAINLESS TUBING & PIPE

Analysis · Tolerance · Finish

- guaranteed on every shipment



ALCOA ALUMINA Catalysts

and Catalyst Supports give bigger yields . . . better quality

If you want to up-grade your catalytic process yields, or simply reduce losses from contamination and side reactions, you'll find it advantageous to insist on ALCOA Aluminas for your catalysts and catalyst supports.

ALCOA Aluminas—*Activated, Tabular* and *Calcined*—help produce better end products at lower costs because they permit close control over rates of reaction . . . reduce carbon-deposit difficulties . . . often lower operating temperatures.

ALCOA Aluminas are uniform in structure and chemical purity . . . stable at elevated temperatures . . . have high resistance to erosion and crushing . . . and are moderate in cost.

Let us send you further information and samples for testing in your own plant. Write to ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION, 716-M Alcoa Building, Pittsburgh 19, Pa.

See our advertisement in Refinery Catalog and Chemical Materials Catalog. For corrosion-resistant heat exchanger tubes, instrument tube, process equipment and architectural items, investigate ALCOA Aluminum.

Alcoa Chemicals

ALUMINUM COMPANY OF AMERICA

Erkote 3X Insulating Mastic on these 40,000 barrel spheroids reduces evaporation losses

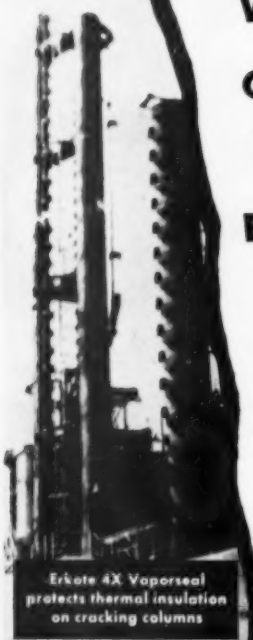
With protective coatings . . .

on-the-job performance is what really counts!

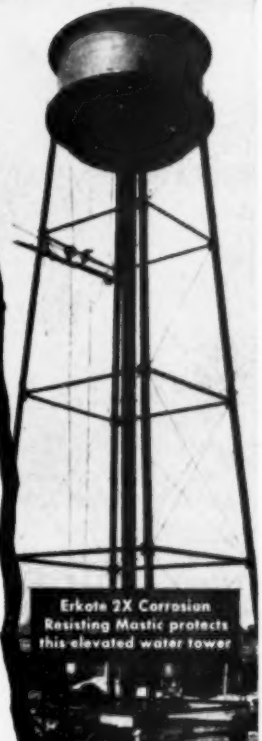
ERKOTE® Mastics have a record of proven dependability

In refineries, in paper mills, in chemical plants . . . in every type of industry where surface protection is a problem . . . ERKOTE Insulating and Corrosion Resisting Mastics provide a permanent protective coating. They are bonded to the surface in one seamless application that offers unusual resistance to chemicals, corrosive fumes and extreme weather conditions. Even under severe thermal changes, ERKOTE Mastics remain flexible . . . never dry out or peel off!

In addition, we produce our own mastics and paints and furnish our own trained crews to apply and maintain ERKOTE products. One source—one responsibility—for materials and workmanship!



Erkote 4X Vaporseal protects thermal insulation on cracking columns



Erkote 2X Corrosion Resisting Mastic protects this elevated water tower

ERKOTE TECHNICAL COATINGS

FOR USE WHERE PAINTS FAIL

see our catalog in Sweet's PLANT ENGINEERING FILE or write for copy

EARL PAINT CORPORATION
240 Genesee Street • Utica, N.Y.

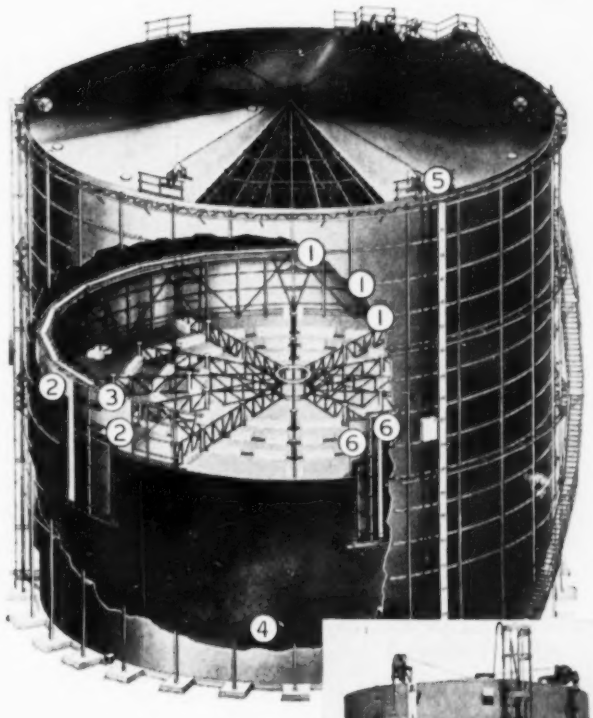
Erkote 3X insulates operating equipment— Erkote 2X rust-proofs steel supports

Erkote Mica Mastic waterproofs and beautifies these masonry buildings

no. **3** *of a series*

GUIDES TO GASHOLDER PLANNING

"Diffusion is bad news in gas storage.
Before we buy we've got to know . . .



1 Top section of shell completely ventilated

2 Wide clearances simplify operation

3 Gas-tight friction-less seal not affected by weather

4 Piston rests on bottom—less than ½ of 1% for purging

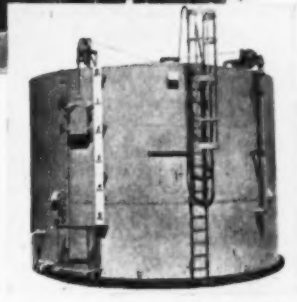
5 Leveling device—independent of side-wall—keeps piston level

6 Fenders prevent all tension in seal

How gas-tight is the seal?"

Helium and tetrafluor-ethylene have characteristics which present a special storage problem. Helium must be stored under conditions which will not permit contamination by even the slightest diffusion of atmospheric air through the seal of its gasholder. Tetrafluor-ethylene is an expensive gas and any escape by diffusion can represent a considerable dollar loss.

Wiggins Gasholders have seals which retain each of these widely different gases without contamination or economic loss. The patented Wiggins dry fabric seal gives air-tight protection against contamination to helium . . . and gas-tight protection from diffusion loss to tetrafluor-ethylene. In installations throughout the country, with all types of gas products, the Wiggins Gasholder with its impermeable *dry* seal has proved itself in years of trouble-free performance.



5,000 cu. ft. Wiggins Gasholder for storing tetrafluor-ethylene

Wiggins Gasholder

WIGGINS VAPOR SEALS GENERAL AMERICAN

GENERAL AMERICAN TRANSPORTATION CORPORATION

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Advertisement

Which of these BASIC MATERIALS will solve *your* processing problems?

Norton Relectric furnace products are engineered and prescribed to meet many manufacturing needs

Backed by over 50 years of experience in electrochemical refining, Norton brings you basic materials whose purity and properties are carefully controlled and consistently duplicated.

These Norton electric furnace products differ greatly in composition and characteristics. They are the source of the many Norton *engineered prescriptions* which have proved of immense practical value in widely varying processes.

Moreover, each of them has possibilities for use which are still undiscovered. It will pay you, therefore, to read the following descriptions very carefully. Even this partial list may contain the exact combinations of properties *you* need.

ALUMINUM OXIDE (ALUNDUM*)

Norton is the world's largest producer of this basic material — fused alumina. *Characteristics:* high melting point, about 3700°F; specific gravity, 3.95; good chemical stability, neutral to most chemical reagents; extreme hardness of 2000 Knoop, with great toughness; reasonably high thermal conductivity, 2½ times that of fire clay; high dielectric strength. *Uses:* heavy refractory furnace shapes; pure oxide and sintered refractories; radio tube insulation; porous media for filtration and diffusion; catalyst carriers and fluid catalysts; heat exchange pebbles; wear-resistant parts; laboratory ware.

SILICON CARBIDE (CRYSTOLON*)

Silicon carbide is produced by Norton in large tonnages. *Characteristics:* high melting point, disassociates at about 4175°F; specific gravity, 3.20; extreme hardness of 2500 Knoop, with excellent abrasion and erosion resistance; high thermal conductivity, 7 to 10 times that of fire clay; excellent resistance to thermal shock; maintains great strength to very high temperatures (PCE, 3350°F — cone 37 to 40); unique electrical qualities; relatively low thermal expansion; no inversion on heating; chemically acidic, with good stability. *Uses:* special refractories for boiler furnaces, ceramic kiln furniture, heat treating, hearth plates, high thermal conductivity muffles and retorts; electrical heating elements; lightning arrestors; metallurgical additions; also available in a Norton-patented process for coating graphite — in rocket nozzles and reaction motor parts, etc. — for increased resistance to erosion by high velocity gases.

MAGNESIUM OXIDE (MAGNORITE*)

Fused magnesia of highest purity. *Characteristics:* extremely high melting point, about 5,000°F; specific gravity, 3.58; electrical resistivity, 10^8 ohm cm at 1000°C; chemically basic. *Uses:* linings for metal melting furnaces; high temperature electrical insulation; refractories for handling corrosive caustic materials.

FUSED STABILIZED ZIRCONIA

Norton was the first to develop fused zirconia for practical commercial use. *Characteristics:* high melting point; thermal conductivity in British Units at 2000°F is 6.2 for dense shapes, 4.7 for insulating shapes, 2.8 for insulating grain; high resistance to abrasion and thermal shock; not wet by most molten metals; changes from a fairly good electrical insulator at low temperature to a conductor at 1000°C. *Uses:* refractories for extremely high temperatures; setter plates for titanates; furnace linings for high temperature gaseous chemical reactions; zirconium chemicals; metal melting furnace linings; catalyst carriers; heat exchange pebbles; reaction engine parts including jet and rocket liners.

BORON CARBIDE (NORBIDE*)

The hardest man-made material, an exclusive Norton development of boron carbide. *Characteristics:* high melting point, 4440°F; specific gravity, 2.50; compressive strength, 414,000 psi; bending strength, 44,000 psi; self-bonding, unaffected by all acid and alkali solutions. *Uses:* abrasive for economical replacement of diamond dust in lapping; high purity powder of micron sizings for use as refractory and in "cermet" combinations; neutron absorption in nuclear reactors or particle accelerators; pressure-blast nozzles; wearproof bushings, slides, etc.

In these Higgins type arc furnaces tremendous amounts of electrical energy are utilized by Norton in electrochemically refining crude minerals into basic R refractory materials.

BORON NITRIDE

Refined by Norton to over 98% purity. *Characteristics:* melts or disassociates at 5400°F; a nonconductor of electricity; weighs only 7 lbs. per cu. ft.; is not oxidized in air at 1200°F. *Uses:* anti-sticking agent for use with molten glass or metal; heat-resistant lubricant; thermal insulator in vacuum or atmosphere furnaces; experimental refractory or crucible material; experimental electrical insulator.

MANY OTHER MATERIALS

Among the high-melting, useful materials made available by Norton are Special Fused Oxides, Refractory Carbides, Refractory Borides, Mixed Borides, Elemental Boron. Research, development and field testing are being conducted on Experimental Borides, Carbides, Nitrides and Silicides. Some of these are in regular industrial use and new uses are being found for others.

AVAILABLE IN MANY STANDARD OR SPECIAL FORMS

Besides supplying these materials in their crude form, more or less as they come from the furnace, Norton has extensive facilities for processing and fabricating — and is ready to work with you in engineering any of these materials to your particular requirements.

GET THIS BASIC MATERIALS BOOKLET

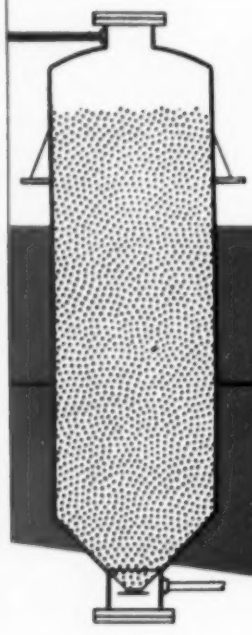
This new Norton Publication, "Basic Materials," contains 22 pages of detailed information, including actual and suggested uses. For your copy, write to NORTON COMPANY, 271 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

R REFRACTORIES

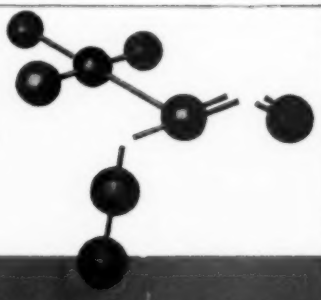
Making better products . . . to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

 (To obtain more data on advertised products see page 1936)



...ready to tackle
any sorptive-mineral job
that comes along...



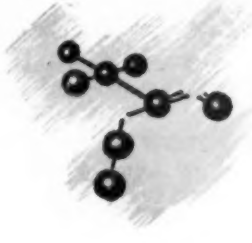
ATTAPULGUS Fullers Earth
POROCEL Activated Bauxites

ADSORBENTS

There's an Attapulgus or Porocel adsorbent to fit your process technique for removing odors, colors, tastes, moisture, acids, sulfur, fluorides and unsaturates from process liquids or gases. Materials treated in principal applications are: motor oils and other lubricating, specialty, and technical oils; petrolatums and waxes; aviation and motor gasoline stocks; kerosene; diesel and heating oils; chemicals and petrochemicals.

CATALYSTS, CATALYST CARRIERS

Our sorptive minerals are recognized standards in desulfurization, reforming and isomerization systems—catalytic removal of unsaturates—conversion of sulfides to elemental sulfur—fluid catalyst applications—as catalyst carrier in copper sweetening processes.



DESICCANTS

We offer a wide range of reliable, thoroughly proved desiccants for drying air, hydrogen, carbon dioxide, hydrocarbon liquids and gases.

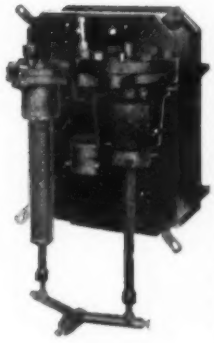
SPECIAL GRADES

Mine and plant facilities permit prompt and economical production of grades meeting individual customer specifications. Our laboratories and technical staffs are ready to assist in research, development, design and operating problems. Your inquiries are invited.

ATTAPULGUS MINERALS & CHEMICALS CORPORATION · **POROCEL** CORPORATION

Dept. D, 210 West Washington Square, Philadelphia 5, Pa.

Taylor Mercury Manometer gives you continuous ranges from 10" to 533" of water!



AND no piping changes are necessary when changing from one range to another, because there are six interchangeable range tubes (10", 20", 50", 100", 200" and 400" of water). All except 10" range may be over or under-ranged 33⅓%. Instrument has pressure connections both at side and top of manometer; a union coupling prevents distortion of bearing housing . . . eliminates binding or friction caused by wrench torque; when necessary for recording two Flows or for Ratio-Flow control two manometers can be mounted on the back of a single case.

NOTE THESE ADDITIONAL FEATURES:

Great power—thanks to extra big float with extra long travel. Microfinished shaft with Teflon bearings "float" this power right through to the pen.

High accuracy—inherent straight line calibration.

Positive actuation—high energy output. Big 3 3/16" float. Long float travel—1". Simple lever system. Teflon in pressure-tight bearing surfaces for efficient use of power. Jewelled thrust bearing.

Dependable performance—submerged check valves give positive shut-off. Unique damping valve adjustable under full pressure without leakage. Ample room in mercury chambers to accommodate surges or pulsating flows. Teflon holds pressure, yet lets shaft turn freely, giving long service.

Ease of maintenance—low pressure chamber cover permits easy access to float and lever arm during calibration. Entire pressure tight bearing easily and economically replaced.

Ask your Taylor Field Engineer, or write for **Bulletin 98182.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.

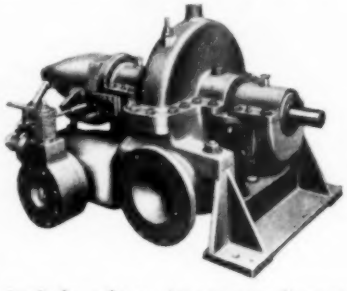
Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

"This engineered oil cushion prolongs turbine bearing life"

Tests on standard ring-oiled bearing construction show that oil being flung off at high shaft speeds was lost to lubrication. An exclusive Westinghouse-designed Wiping Shield solves this by directing the oil back on the bearing. This results in more oil on the bearing . . . enabling it to stay in service for extremely long periods and stand up under severe running conditions. Soundness of this reinforced oil cushion was proved right in the bearing itself by imbedding thermocouples throughout the babbitt. When measured during exhaustive floor tests, temperatures showed total elimination of "hot spots".

This important refinement exemplifies the thoroughness of Westinghouse continuing program to build more and more efficient prime movers. A program based on—over 50 years' experience in turbine design and manufacture . . . research and development skill . . . complete production facilities . . . full-scale floor testing . . . quality components . . . wide range of capacities, from 1 hp to the largest made . . . and expert field and application ability.

The Type E General-Purpose Turbine



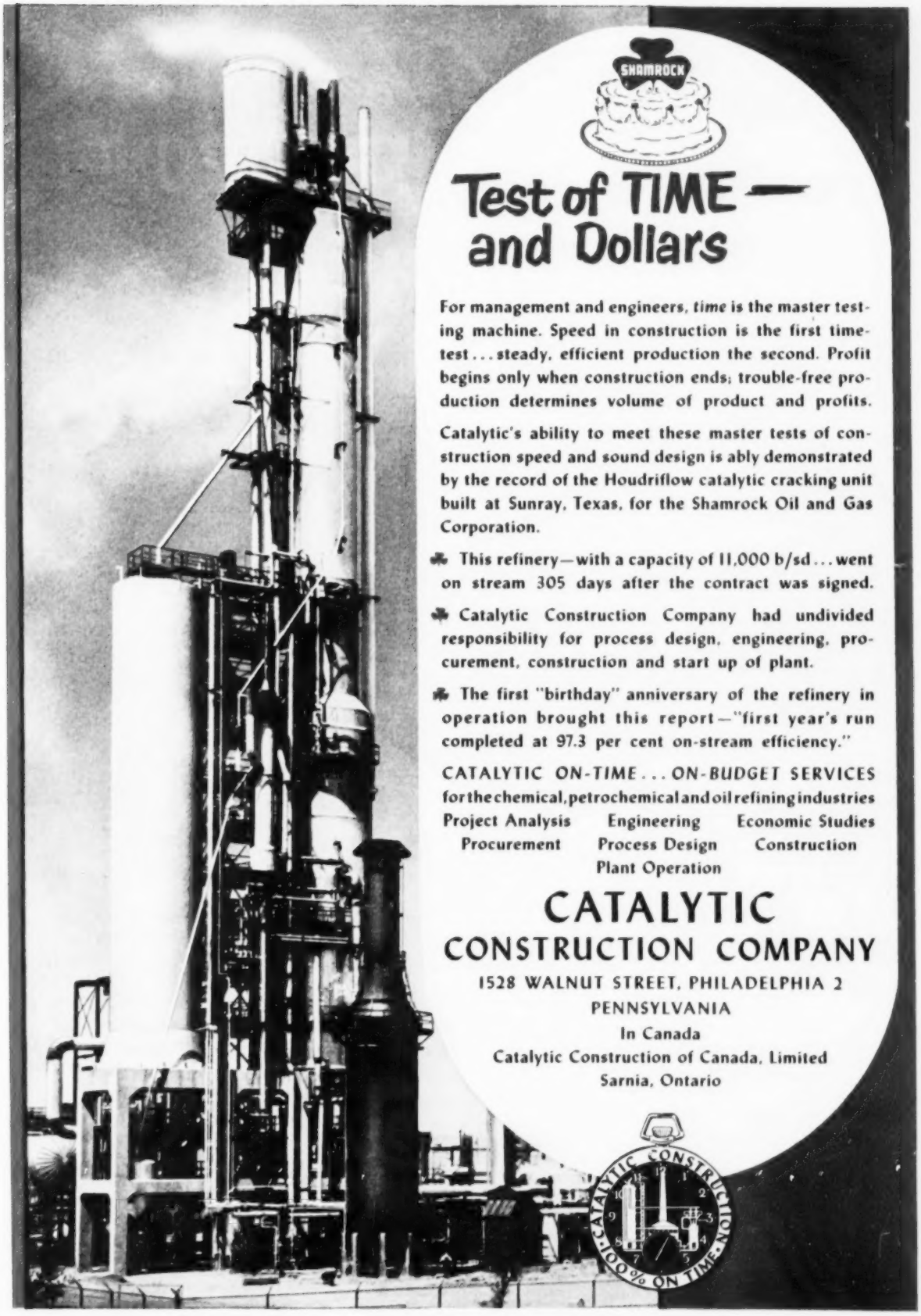
Type E-116 is the smallest member of the Type E family and is rated up to 500 hp. It is a typical product of Westinghouse engineering progress and includes these important features: dual protection against overspeed; weather-resistant construction; centerline support and interchangeable parts. Other Type E sizes are also available, with ratings through 1500 hp, to cover a wide variety of applications.

Consult your Westinghouse Sales Representative who is well equipped to assist in specifying the correct size and accessories for maximum economy, operating efficiency and dependability; or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50553

Turbines for every industrial use

YOU CAN BE **SURE**...IF IT'S

Westinghouse


SHAMROCK
Test of TIME — and Dollars
For management and engineers, *time* is the master testing machine. Speed in construction is the first time-test . . . steady, efficient production the second. Profit begins only when construction ends; trouble-free production determines volume of product and profits.
Catalytic's ability to meet these master tests of construction speed and sound design is ably demonstrated by the record of the Houdriflow catalytic cracking unit built at Sunray, Texas, for the Shamrock Oil and Gas Corporation.
♣ This refinery—with a capacity of 11,000 b/sd . . . went on stream 305 days after the contract was signed.
♣ Catalytic Construction Company had undivided responsibility for process design, engineering, procurement, construction and start up of plant.
♣ The first "birthday" anniversary of the refinery in operation brought this report—"first year's run completed at 97.3 per cent on-stream efficiency."
CATALYTIC ON-TIME . . . ON-BUDGET SERVICES
for the chemical, petrochemical and oil refining industries
Project Analysis Engineering Economic Studies
Procurement Process Design Construction
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CATALYTIC
CONSTRUCTION COMPANY
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PENNSYLVANIA
In Canada
Catalytic Construction of Canada, Limited
Sarnia, Ontario
CATALYTIC CONSTRUCTION
100% ON TIME

Check the SAFETY ZONE

Yes . . . check the safety zone before ordering valves. Check . . . for voids in the body that could retain fluid when the valve is closed or open.

LISTED UNDER REEXAMINATION SERVICE UNDERWRITERS' LABORATORIES, INC. UL TYPE "G"

ORBIT VALVES ®

ORBIT Forged Steel LP GAS VALVES are designed so that there are no voids in the body of the Valve, for fluids to become trapped that could feed a fire or contaminate a different product. When the valve is closed it drains clean.

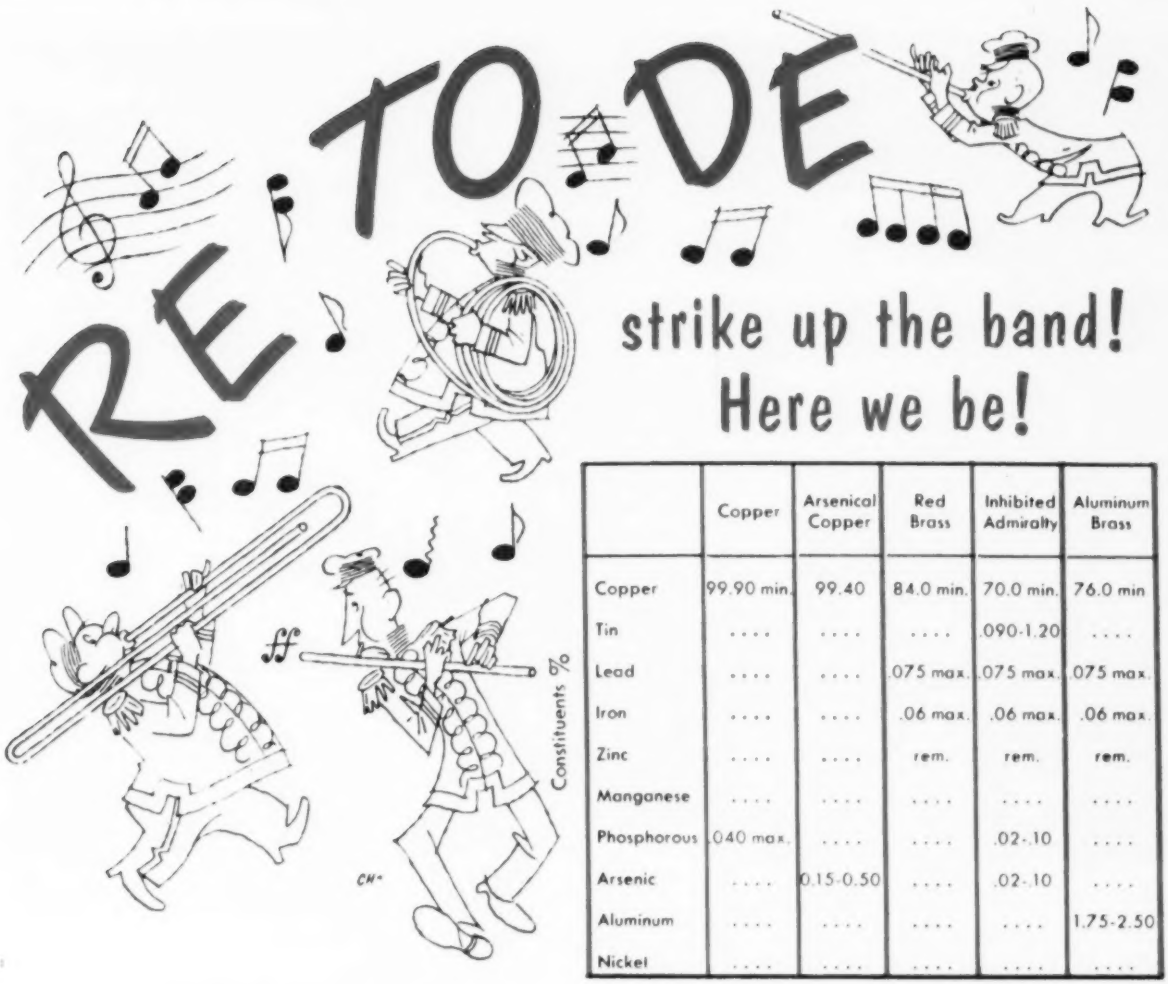
Your Supply Store carries ORBIT Forged Steel Valves in stock. Sizes 1" to 4". ASA Ratings 150 lb. Class to and including ASA 2500 lb. Class. Screwed and Flanged Ends. Maximum Rated Working Temperature 250° Fahrenheit.

BRANCHES

HOUSTON, TEXAS, 407 Velasco
(Serving the Gulf Coast)
ODESSA, TEXAS, 402 West County Road
(Serving West Texas)
CASPER, WYOMING, 1740 E. Yellowstone
(Serving the Rocky Mountain States and Canada)

ORBIT VALVE COMPANY

P. O. BOX 699 **TULSA, OKLA.**



	Copper	Arsenical Copper	Red Brass	Inhibited Admiralty	Aluminum Brass
Copper	99.90 min.	99.40	84.0 min.	70.0 min.	76.0 min
Tin	....	....	....	.090-1.20	....
Lead	....	....	.075 max.	.075 max.	.075 max.
Iron	....	....	.06 max.	.06 max.	.06 max.
Zinc	....	....	rem.	rem.	rem.
Manganese	....	....	....	....	....
Phosphorous	.040 max.	....	....	.02-.10	....
Arsenic	....	0.15-0.50	....	.02-.10	....
Aluminum	....	....	....	....	1.75-2.50
Nickel	....	....	....	....	....

RE... TO DE..... Adding the missing letters (indicated by dots) you make the entire line read: READY TO DELIVER

Ready to deliver to you the condenser tubing you require in any of the alloys and popular sizes shown on the chart above.

You'll want to specify Wolverine condenser tubing because its entire manufacture is subjected to more controls than most any other tubing. Every possible attention is paid to wall thickness and lengths, and the tubing undergoes special quality tests before it is released for shipment. Close tolerances, quality testing and special handling (all routine matters with Wolverine) go to make this condenser tubing the outstanding performance-standard in the industry—The tube to specify for dependability . . . Wolverine.

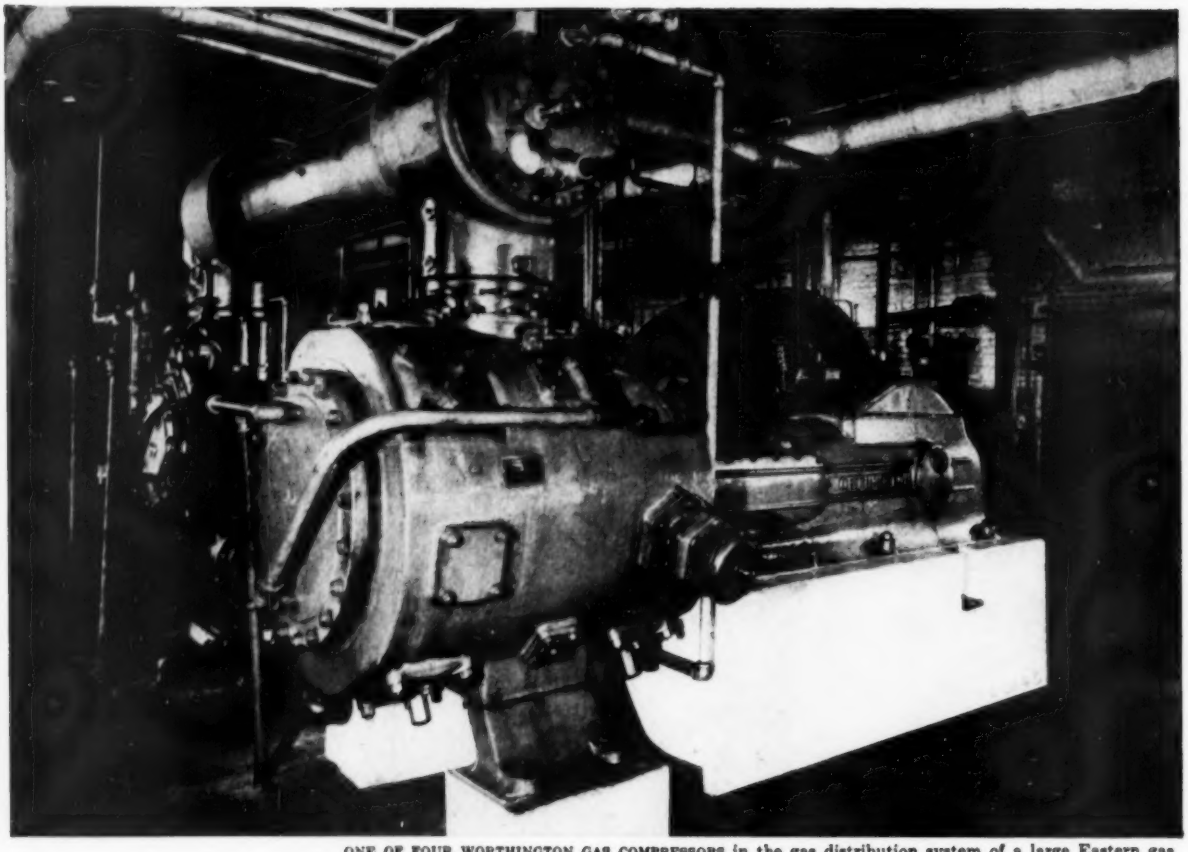
WOLVERINE TUBE DIVISION
of CALUMET & HECLA, INC.

ESTABLISHED 1916

Manufacturers of Quality-Controlled Tubing
1425 CENTRAL AVENUE • DETROIT 9, MICHIGAN

Plants in Detroit, Mich. & Decatur, Ala. *Sales offices in Principal Cities*

EXPORT DEPT., 13 E. 40th ST., NEW YORK 16, N. Y.



ONE OF FOUR WORTHINGTON GAS COMPRESSORS in the gas distribution system of a large Eastern gas company. Compressor is positive displacement reciprocating type with capacity of 125,000 standard cu ft of manufactured gas per hour. Maximum discharge pressure is 100 psi. Volume is controlled by Worthington's automatic variable capacity control.

When a large Eastern gas company needed another gas compressor...

... There was no question about which make should be selected!

The gas compressor in the picture had been working so well since 1949 that Worthington was the logical choice for the *next* new compressor to handle expanded capacity.

These Worthington features constantly increase the number of such choices:

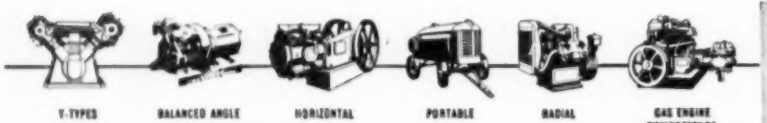
Accurate control of volume that is always assured with Worthington's automatic variable capacity control — acknowledged most accurate, flexible and simple control obtainable.

Worthington's exclusive Feather Valve* — simplest, lightest, most efficient ever made — eliminates valve problems. And Worthington's high-efficiency intercooler needs less water, less power, less attention.

Somewhere in the broad line of Worthington compressors, for air, gas or other "compressables", there is the one right type and size for your job. *Worthington Corporation, Compressor Division, Buffalo, N. Y.*

*Reg. U. S. Pat. Off.

K.2.15



No Other Compressor Will Outperform a Worthington

WORTHINGTON

Compressors

REFINERY PROCESS NEWS

PUBLISHED BY REFINERY PROCESS DIVISION, THE M. W. KELLOGG COMPANY — DECEMBER 1953

Chile's First Refinery Now Well Underway

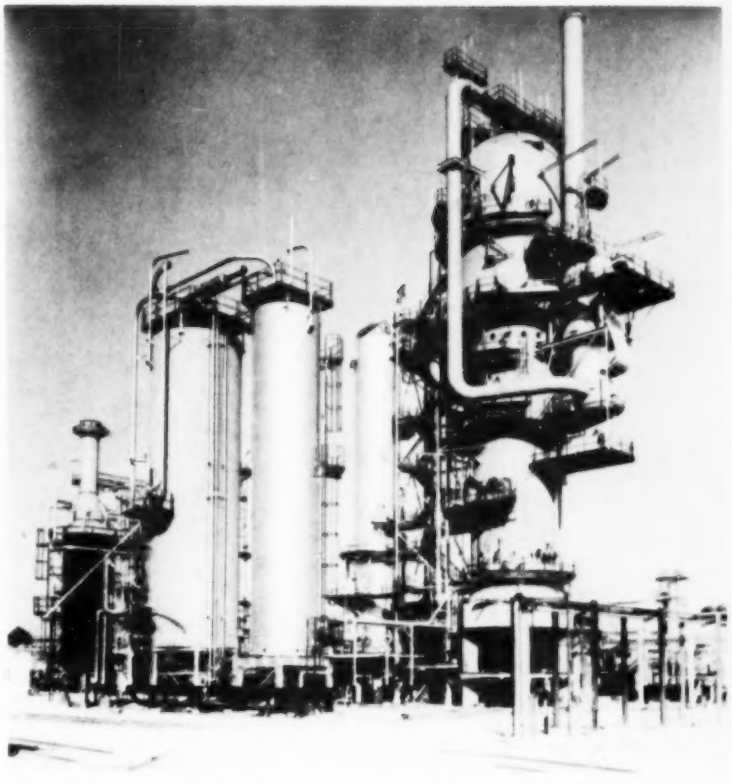
Construction is now well underway on Chile's first petroleum refinery. It was designed by Kellogg and is now being erected under supervision of Kellogg Pan-American Corporation. The new plant will be located ten miles north of Valparaiso and is expected to be on stream by mid-1954.

This $10,000,000 refinery, being built for Expresa Nacional del Petroleo, will have a crude charge capacity of 20,000 BPD and will employ the most modern type of combination thermal equipment to process either indigenous or imported petroleum.

Processing steps include topping, visbreaking, gas oil cracking, thermal reforming, gasoline stabilization and treating. In addition to motor gasoline, the refinery will produce LPG, tractor distillate, kerosene, two grades of diesel oil and heavy fuel oil.

This is only one of several major projects currently underway in South America by Kellogg. Others include a complete refinery in Argentina; two refineries (of 5,000 BPD and 10,000 BPD capacities) and nitrogen fertilizer facilities at three different locations in Brazil.

Shown in the foreground is the stabilizer tower of the new refinery while in the background is the framework of the furnace for the naphtha reformer.



First Model "B" Orthoflow Cracker Goes on Stream Smoothly at Toledo

The first of Kellogg's new Model "B" Orthoflow Fluid catalytic cracking units has now been put on stream at Pure Oil's Toledo refinery. Reports from the first three weeks of operation indicate that the new design is completely successful. Catalyst loss is at a minimum, coke-to-conversion ratio is low, and flexibility excellent.

This new model is one of two versions of Kellogg's exclusive Orthoflow design both of which involve the single vessel construction with straight-line flow of catalyst. The Model "B" Orthoflow, as differentiated from the Model "A," has the regenerator placed above the reactor. As a result, the regenerator is operated at a lower pressure than in the Model "A", which brings about savings in direct operating costs due to reduced horsepower requirements for compression of regenerative air.

For example, in the Model "A", pressure of about 18 pounds is required in the regenerator with a simultaneous pressure of ten pounds in the reactor in order to maintain the optimum circulation of catalyst from one zone to the other. In the newer "B" design, the reactor pressure is held at about 15 pounds while the regenerator is operated at a pressure in the order of seven pounds—retaining the same eight pound differential while simultaneously transferring the major compressor requirements to the lower pressure side of the operation.

In addition to obtaining a significant decrease in the compressor horsepower required to supply combustion air to the regenerator, this arrangement has another advantage. The higher reactor pressure permits a slight decrease in the size of this vessel as well as in that of the fractionator.

(Continued on reverse side)

REFINERY PROCESS NEWS

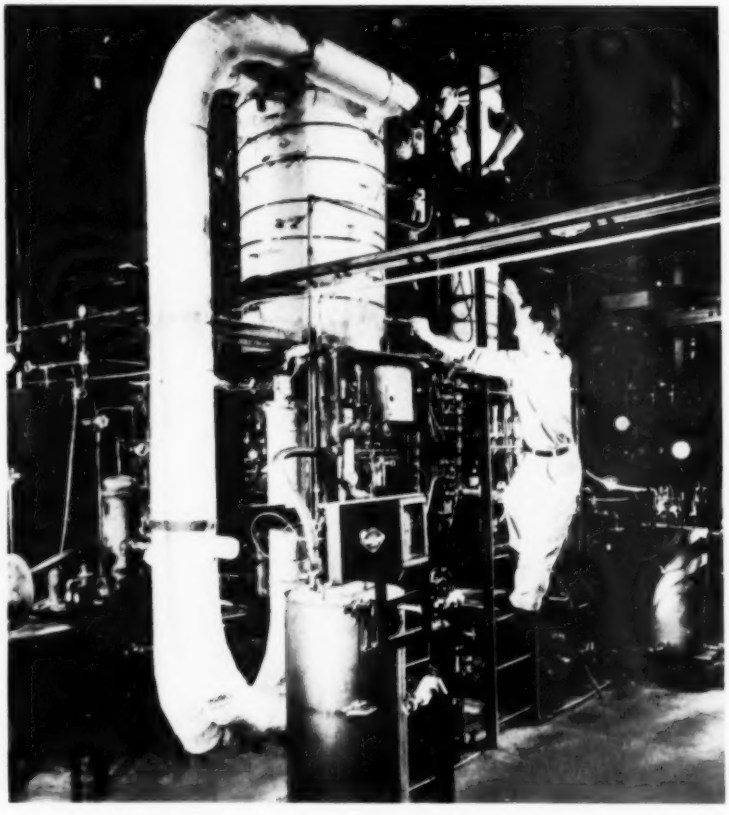
CONTINUED FROM PRECEDING PAGE

Model "B"...continued

While on the surface it would appear that the Model "B" should always be preferred over the Model "A" this is not necessarily the case. The final selection is inevitably dependent upon the individual refiner's processing requirements.

Regardless of which type a refiner installs, commercial operating experience with the five Orthoflow units already built by Kellogg clearly establishes the superiority of this new design. For example, just recently a Model "A" design was placed on stream abroad. The ease with which the unit can be started up and operated is indicated by the fact that Kellogg's operators were released only six weeks after placing the plant on stream. At that time the unit had completed a thoroughly satisfactory demonstration run and had been accepted by the refiner. Considering that the Kellogg operators faced a language barrier in training the refiner's operators in addition to dealing with equipment of foreign manufacture, there's slight question but that this short start-up and indoctrination period constitutes an excellent performance record.

Meanwhile, six other Orthoflows are underway. With capacities varying from less than 2000 to more than 28,000 BPD in fresh feed, they are going up on sites in as widely separated sections of the world as Australia, Texas, Pennsylvania, Yugoslavia and Canada.

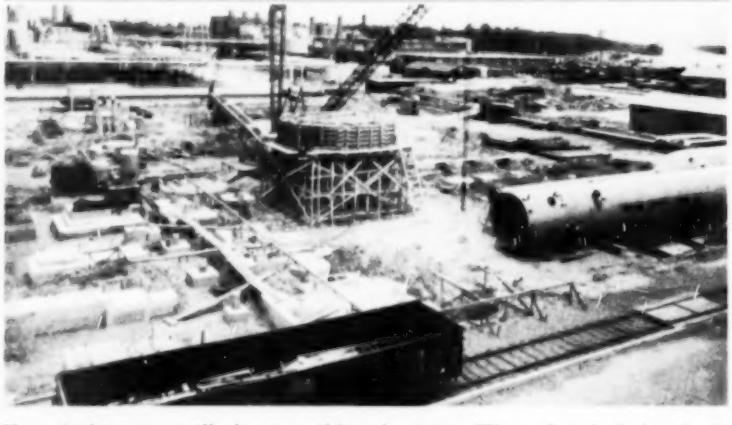


New Pilot Plant for Data on Platinum Catalyst Life

Shown here is a new four-barrel-per-day pilot plant Kellogg has just completed in its extensive pilot plant laboratories in Jersey City. It is currently being used to pinpoint the ultimate life of the regenerative-type Sinclair-Baker RD-150 platinum catalyst.

Two commercial units employing the RD-150 catalyst are now underway, one on the East Coast and one in the Midwest.

Foundation Work Marks Site of New Fluid Hydroformer



Foundations are well along on this large Fluid Hydroformer—one of two currently being erected for Cities Service. This one at Lake Charles is scheduled for completion in 1954. The other is being built at East Chicago.

Still a third Fluid unit is now being engineered for another refiner located in the Mid-West.

For further information, technical data, etc., on any refining process, write

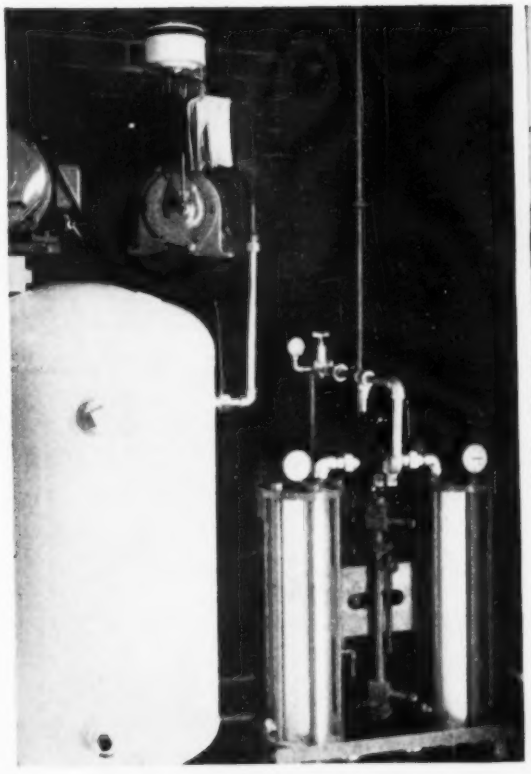
REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

225 Broadway, New York 7, N. Y.

Also Jersey City,
Los Angeles, Tulsa, Houston, Toronto,
London and Paris

KELLOGG PULLMAN



This Lectrodryer, tiny but dependable, dries the air as it goes into the receiver. Automatic instruments feed it to lines controlling pumps in the building to the right and to valves on this pipeline distribution manifold.

LECTRODRYERS* keep moisture from choking automatic controls

Air-actuated instruments trigger valves, start pumps and keep traffic-control-indicators alive at this Platte Pipeline pumping station, Salisbury, Missouri. Moisture in the instrument air can kill this entire automatic operation.

That's why these pumping stations are equipped with Lectrodryers . . . to do away with the moisture that might choke air lines and controls with ice, rust, scale and sludge. Air from the compressors first passes through a Lectrodryer. And, no matter how high the humidity is out-of-doors, no moisture gets past this dryer into the lines.

Elsewhere in Industry, Lectrodryers are DRYing air, gases and organic liquids; preventing contamination of products, helping to hold delicate reactions on the beam and speeding up production. Standard models, proved in many years of service, are available . . . to handle small or tremendous volumes, pressures up to 6,000 psi, dewpoints below −110° F.

The booklet, "Because Moisture Isn't Pink", describes many of these installations. Write for a copy, or tell your troubles with moisture to Pittsburgh Lectrodryer Corporation, 332 32nd Street, Pittsburgh 30, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

Combined trip-throttle valve permits operator to throttle steam directly into G-E Type DP Mechanical-Drive Turbine, usually eliminating need for extra valve in steam line.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Combined Trip-throttle Valve Cuts Turbine Installation Costs

To save you the cost both of buying and installing a throttle valve in the steam line, General Electric designed into its standard Type DP mechanical-drive turbine a trip valve which also functions as a throttle valve. This feature alone can save you up to $200.00 at time of installation.

The combined trip-throttle valve controls steam admission to the turbine on starting and also shuts off all steam in case of overspeed. No need in most cases to shut off steam valves ahead of the turbine before restarting the unit. The combined trip-throttle valve can quickly be reset and the turbine put back on the line, saving you time in an emergency.

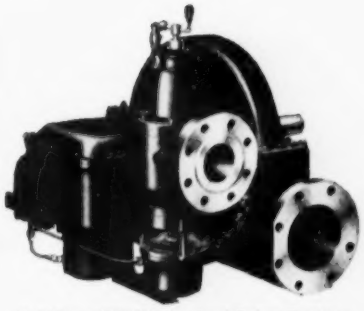
THIS COMBINED TRIP-THROTTLE VALVE is just one of many DP features which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features to save you extra costs. For more information contact your nearest G-E apparatus sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 252-63

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

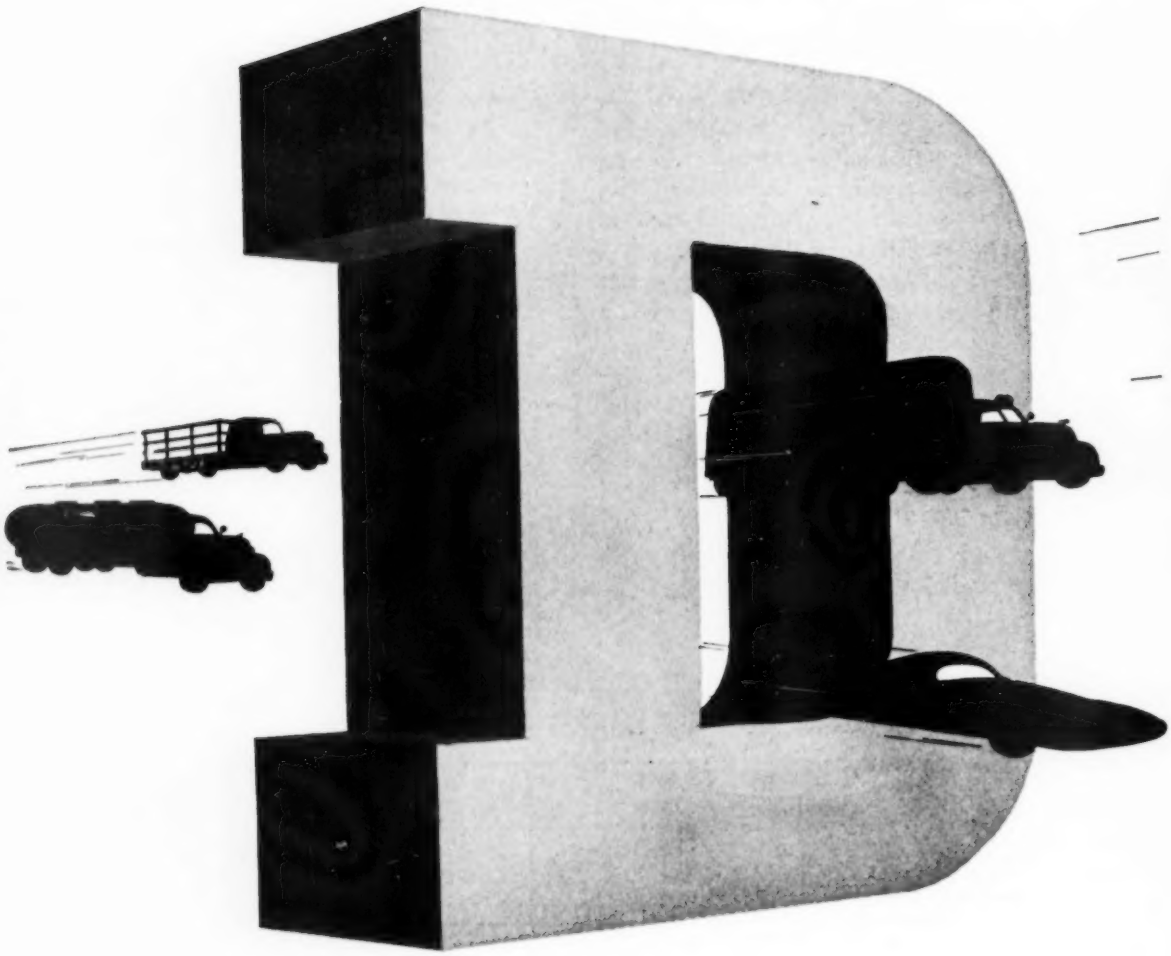
THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



G-E Type DP Mechanical-Drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E standard Type DP turbines are your most economical buy.



DAVISON DEPENDABLE CATALYSTS BUILD BETTER MOTOR FUEL

The operating efficiency of synthetic fluid-type cracking catalysts is important. This operating efficiency can be assured by uniformity of physical characteristics and chemical purity. Davison's production of microspheroidal (M-S*) is tops in uniformity . . . providing all users with a highly efficient synthetic fluid-type cracking catalyst. Your requirements can also be supplied in ground (DA-1*) form. Write for further descriptive information. Experienced Davison Field Service Engineers backed up with complete laboratory testing facilities are part of Davison's service.

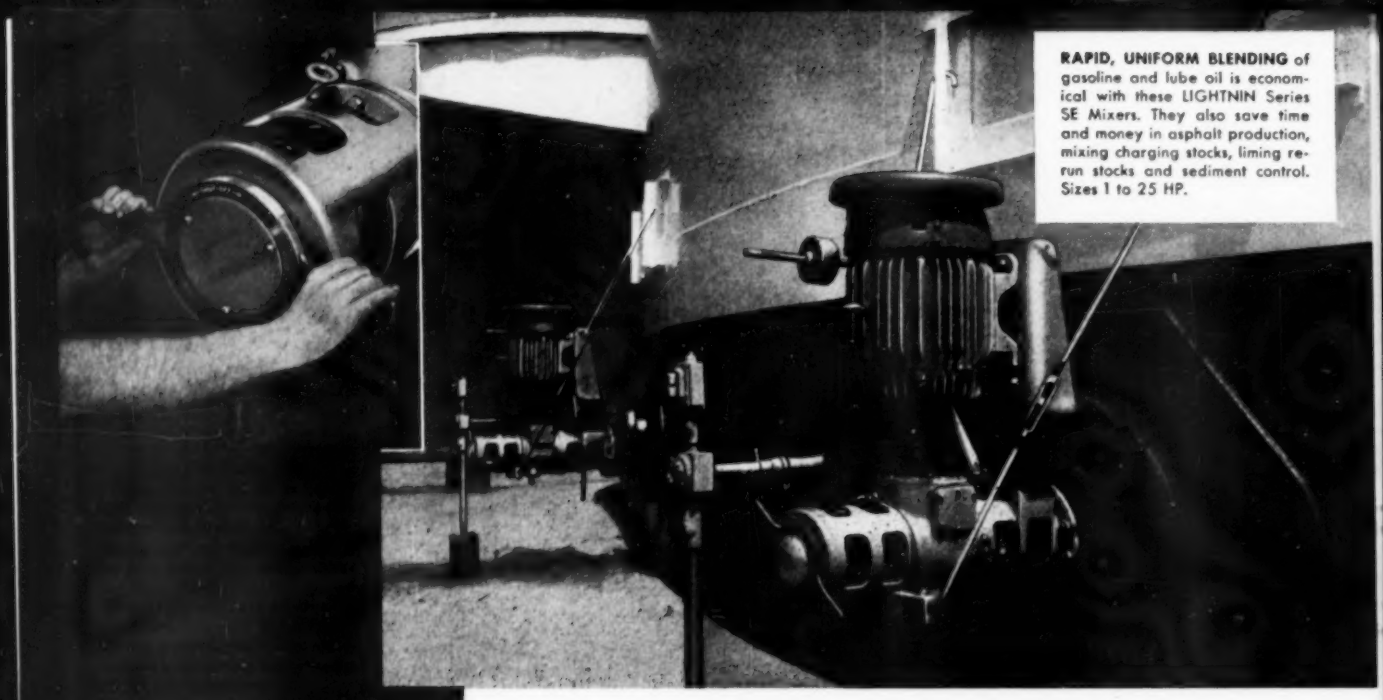
*T.M.T.D.C.C.

Progress Through Chemistry

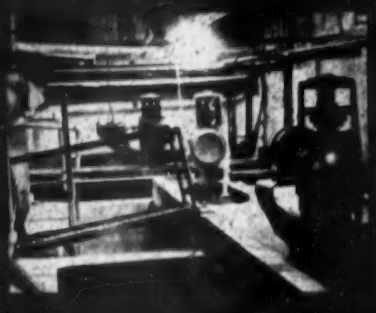
THE DAVISON CHEMICAL CORPORATION

Baltimore 3, Maryland

PRODUCERS OF: CATALYSTS, INORGANIC ACIDS, SUPERPHOSPHATES, PHOSPHATE ROCK, SILICA GELS, SILICOFLUORIDES AND FERTILIZERS



RAPID, UNIFORM BLENDING of gasoline and lube oil is economical with these LIGHTNIN Series SE Mixers. They also save time and money in asphalt production, mixing charging stocks, liming rerun stocks and sediment control. Sizes 1 to 25 HP.



Blend 10,000 gal. of lube oil in 20 min.

...save up to 50% on HP input

Now you can blend 10,000 gallons of lube oil in only 20 minutes with just one 7½ HP LIGHTNIN Series SE Mixer.

The exceptionally high volumetric flow of these units not only cuts blending time, but assures uniform viscosities with no "dead spots" in the tank.

Yet, this is only one of the applications which can be performed better and faster with these mixers. For example, you can slash hours off gasoline blending and ethylizing time; cut back asphalt in ⅛ the time required by recirculation; uniformly mix charging stocks.

Tank farm operators are also saving thousands of dollars in cleaning costs and storage space, by using these units to control bottom sediment.

GUARANTEED RESULTS

Best of all, you eliminate guesswork when you use LIGHTNIN Mixers. Thorough, progressive research enables MIXCO to accurately predict your processing results—and guarantee those results or your money back.

Send for Catalog B-104 and get the facts on the savings possible with LIGHTNIN Side Entering Mixers. Mail the coupon today.

Lightnin® Mixers

MIXING EQUIPMENT Co., Inc.

131 Mt. Read Blvd., Rochester 11, N. Y.

In Canada: William & J. G. Greey, Ltd., Toronto 1, Ont.

- ☐ DH-50 Laboratory Mixers
- ☐ B-75 Portable Mixers (electric and air driven)
- ☐ B-102 Top Entering Mixers (turbine and paddle types)
- ☐ B-103 Top Entering Mixers (propeller type)
- ☐ B-104 Side Entering Mixers
- ☐ B-106 Condensed Catalog (complete line)
- ☐ B-107 Mixing Data Sheet

Please send me the catalogs checked at left.

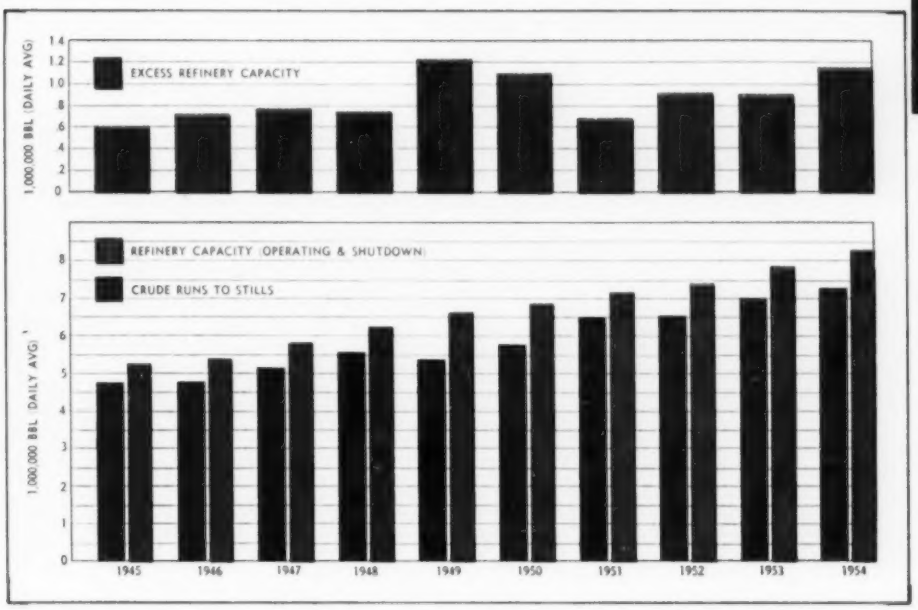
Name_____ Title_____

Company_____

Address_____

City_____ State_____

PETROLEUM PROCESSING
DECEMBER, 1953



EXCESS REFINING CAPACITY is building up — and will reach an estimated 1,200,00 b/d next year, the highest level since 1949

What's the Picture for '54?

Industry experts give their ideas on supply, demand, stocks, technology

A STAFF REPORT
by the Editors of
Petroleum Processing

TWO important developments now shaping up are going to influence refinery operations next year. Industry experts see these as:

1—The need for industry to balance crude runs to stills to bring product stocks more into line with demand. A complicating factor here is that the industry may have surplus refinery capacity of over 1,200,000 bbls. daily by the end of 1954.

2—Manufacture of higher octane motor fuels, particularly the premium grades, through more intensive use of catalytic reforming. Premium motor fuels in some parts of the east may reach 95 Research octane next year. Only a few months ago it was thought that 94 would be about tops for next year.

At first glance, these two developments might seem unrelated. However, large naphtha and gasoline stocks are resulting in the greater availability of selected virgin naphthas as feed stock for catalytic reforming—and therefore are helping to push octanes up.

Product yields suffer through reforming—as much as 20% or more of the charge—when fuels of 94-95 Research octane are produced. This loss in yields can be absorbed under present conditions of surplus crude supplies and large product inventories.

And refiners, meantime, are readying themselves for the time when higher compression automobile engines are available. They will be ready to provide motor gasoline which will give the motorist increased power from the fuel he puts in his tank, and which will more than offset yield losses.

In studying developments coming in 1954 which will affect refiners' operations, PETROLEUM PROCESSING Editors questioned seven economists, all with oil companies marketing either nationally or over an area of several states. Their views reflect nation-wide conditions except for estimates on product demand, which are sensitive to industrial trends in their own territories. Four major topics were explored—demands, runs to stills and stocks, gasoline quality, and exports.

Since the views expressed are their own predictions and not necessarily those of their companies, it was agreed that neither their nor their

Products Demand for 1954 by Quarters

(As Forecast by the Independent Petroleum Assn.)

	Thousand Bbls. Daily Average					
	Year 1953	1st Q 1954	2nd Q 1954	3rd Q 1954	4th Q 1954	Year 1954
Gasoline	3,470	3,265	3,775	3,830	3,560	3,607
Kerosine	364	520	235	225	495	369
Distillate	1,488	2,170	1,180	1,035	1,890	1,568
Residual	1,651	1,845	1,515	1,425	1,735	1,631
Other products	1,153	1,055	1,165	1,280	1,125	1,157
Totals	8,126	8,855	7,870	7,795	8,805	8,332

Stocks of Principal Products for 1954 by Quarters

(As Forecast by the Independent Petroleum Assn.)

	Million BBls., Closing Day of Quarter					
	Year 1953	1st Q 1954	2nd Q 1954	3rd Q 1954	4th Q 1954	Year 1954
Gasoline	146	167	151	138	147	147
Kerosine	26	16	27	37	28	28
Distillate	103	54	84	125	102	102
Residual	44	38	44	53	47	47
Totals	319	275	306	353	324	324

companies' names would be used.

As the "M.C." sometimes announces during a radio program, "Let's see what the experts say":

1—Product Demands

What increases in domestic demand for motor fuel, heating oil and residual fuel oils do you believe likely in 1954?

". . . I look for an increase in domestic demand for motor fuel of betweeen 3.5-4%; for kerosine 6-6.5%; for distillates 7.5-8.5%. I look for a decrease of 3.5-4.5% in residual fuel oil demand. The extent will depend on the severity of the readjustment now beginning to take place which, while not reversing growth trends, will slow them up slightly." From a Pacific Coast company.

". . . Gasoline demand will be up 4%, kerosine 3%, distillates 8.5%, residual no change, all other products up 5%; for all products an increase of about 4% over 1953." A middle west company.

". . . My forecasts are: gasoline up 4.2%, kerosine 6.3%, distillate 8.7%, while residual fuel will be 4.5% less. In general economic conditions we expect a drop of 10% in the average level of industrial production, a 25% drop in passenger car production, 23% decline in new housing starts, 15% less space heater installations, and a 20% reduction in power burning installations.

"The weather factor we use is approximately 4% warmer than the 'old' Weather Bureau normal, which, if realized, would imply a 6% gain over the very mild weather experienced in 1953." An eastern company.

". . . We expect domestic demand for motor gasoline to increase 4.7%, heating oils 7.8% and residual fuels to decrease 2.8%." A company in the southwest.

". . . We believe demand for all gasolines will increase 5%, for heating oils (kerosine, furnace and diesel oils) 10%, residual fuels 2%." A middle east oil company.

". . . Domestic motor fuel demand will increase 4%, distillate heating oils 13%, total distillate fuel and diesel oils 8% and residual fuels 1%." From an Eastern Seaboard company.

". . . We expect motor fuel demand to increase 4.5% and heating oils 10.5%, and residual fuels to decrease 2.3% in 1954 from 1953." An Eastern Seaboard company.

2—Runs to Stills, Stocks

Our own idea is that runs to stills will remain high and stocks will continue at high levels, but that the oil companies will find they can live with these conditions and still make a profit. What are your ideas?

". . . At the moment stocks of crude oil are above the required levels. On the other hand, any severe deviation from normal consumption patterns calling for an increased volume of finished products would quickly reduce the apparently high stocks. The experience of the oil industry in the post-war period has been that it cannot afford to have an oil shortage. Surpluses are expensive in the short run, but shortages are disastrous at any time.

"In any analysis of inventories, differences between district pictures must be recognized. The prolonged warm weather in our territory has helped reduce the disability felt by the lower-than-normal heating oil stocks and possibly has reduced some of the surplus of gasoline. The true answer will not come until we have experienced the winter weather and are able to ascertain the adequacy of current capacity operations plus seasonal accumulation of distillates."

". . . Crude runs to stills for balanced operations next year need not exceed 7,100,000 to 7,000,000 b/d, or only slightly in excess of the average level for 1953. This would permit resorption of the present burdensome stock position while still providing an ample cushion to meet any sudden surges in demand. The industry now has spare capacity in both production and refining, as well as transportation. Therefore, stocks need not be as high because sudden upward shifts in demand can be met quickly and easily, and the cheapest storage place is still the underground reservoir."

". . . Runs to stills in 1954 will be up about 2.5% we believe, and product stocks will be increased by about 25,000,000 bbls. However, profit margins may be reduced by lower refinery realizations. We believe gasoline prices will be weak at least through next spring.

"Because of an unrealistic gasoline/distillate price relationship, the industry this summer overproduced gasoline to the extent that now, at the start of the winter season, inventories are top-heavy. This poses a problem for refiners in meeting the winter's normal distillate demands without further serious deterioration in its gasoline position by next spring.

"To accomplish this design, middle distillate yields must average approximately 2 yield points over those of last winter. Even this pattern will make gasoline stocks April 1 some 11-12,000,000 bbls. above last spring."

". . . Crude runs currently have been reduced sufficiently so that, if this level is maintained for the rest of the year, inventory excesses will be eliminated and we can go into 1954 with what might be termed normal stocks of all products.

". . . Prior to World War II we were accustomed to refinery operations at 80-85% of capacity and to a re-

serve crude oil productive capacity of at least 1,000,000 b/d. With a return to more modest rates of increase in demand, it is my feeling the industry will adjust its operations to meet changing conditions."

". . . Runs to stills seem to be in process of adjustment and stocks will probably be partially adjusted during the last quarter of 1953."

". . . We believe the industry will become accustomed to a high level of stocks from here out. There will be some downward adjustment in runs made necessary by lack of availability of storage capacity."

3—Gasoline Quality

As you know, Esso Standard Oil Co. is introducing a new premium motor fuel and saying, "In sheer high-compression, knock-free power, it will be the very finest gasoline you can buy." **A few weeks ago Cities Service launched an extra premium motor fuel, claiming among other advantages,** "improved automotive operation due to high octane."

Do you think this presages continued rapid installation of catalytic reforming units as the refiners get set to meet higher octane competition?

". . . I look for a continuation of the trend toward higher octane motor fuel, although it is unfortunate that the industry must continue to increase the quality of its product without adequate compensation for the increased value."

". . . This [continued installation of catalytic reforming] is undoubtedly true and we can also look forward to further substantial increases in catalytic cracking capacity."

". . . The industry in 1954 will continue the rapid installation of catalytic reforming units to provide for meeting demands for higher octane motor fuels."

". . . We will also probably see an accelerated technological movement toward reduction of residual fuel oil volumes in every part of the country. On a volumetric basis, residual fuels at present distress prices fall far short of paying their own way for the refiner. The price does not cover half of the prorated share of the cost of crude used in its manufacture.

"This means that technological developments will be required to reduce further the volume of heavy fuels produced and to increase the volume of light products. Refiners have been discouraged from too rapid a movement in this direction because of the high cost of construction or conversion of refining facilities. At present there is little choice and if only to minimize the loss they face, economics makes mandatory conversion of older plants to enable lower residual yields."

(We are already making headway in this direction. Yields of residual fuels have dropped from 25.4% in 1946 to 17.8% U.S. average for 10 months of 1953. The increased yields of light products resulting, however, build up these stocks faster during periods of over-production in refineries.—Ed.)

4—Exports

Will the increasing output of European and other refineries outside the U.S., plus maybe the resuming of operations in the Abadan refinery in Iran, mean more competition from foreign sources of supply in the markets of American oil companies?

". . . It is felt that exports from the U.S. will decline further, because large additions to refining capacity are under way in other countries and a portion of them should come on stream in 1954. Tentatively, a decline in exports of some 17 to 20% from 1953 looks possible."

". . . The increasing output of foreign fields and refineries should tend to make the foreign circuit more self sufficient. We estimate a decline of 19.5% in exports from the U.S. It is unlikely the Abadan refinery will reach sizeable volumes early enough in 1954 to materially affect our own markets."

". . . Assuming an increase in demand for petroleum products outside the U.S. of up to 7%, it is unlikely that added foreign refining capacity will increase competition in our normal markets to any great extent through 1954."

". . . One of the critical elements in the world outlook is how the world will absorb the Iranian production when the Abadan refinery comes back on stream."

". . . We do feel there will be increasing pressure from foreign sources of supply in our domestic markets this coming year."

Capital Outlays for Refining Up in 1954

INDICATIONS are that U.S. oil companies generally plan to increase their capital expenditures in 1954 for manufacturing and marketing, but reduce those for production and transportation, as compared with estimated 1953 capital expenditures.

Capital outlay for manufacturing in 1954 will be $442,801,000 as compared with a 1953 figure of $379,177,000—up 16.8%. Figures for the other three main categories of the industry are as follows:

Marketing—$198,848,000 for 1954 compared with $179,063,000 for 1953—up 11.0%.

Production—$814,319,000 for 1954 compared with $835,161,000 for 1953—down 2.5%.

Transportation — $78,475,000 for 1954 compared with $168,958,000 for 1953, down 53.6%.

These data were furnished by 15 large integrated oil companies on operations wholly within the U.S. in the second annual survey completed recently by *Platt's Oilgram News Service*, a McGraw-Hill Petroleum Publication. In the case of some of the larger companies, figures submitted covered a dozen or more subsidiaries.

Companies reporting account for 4,306,773 b/d, or about 54% of the present total U.S. refining capacity.

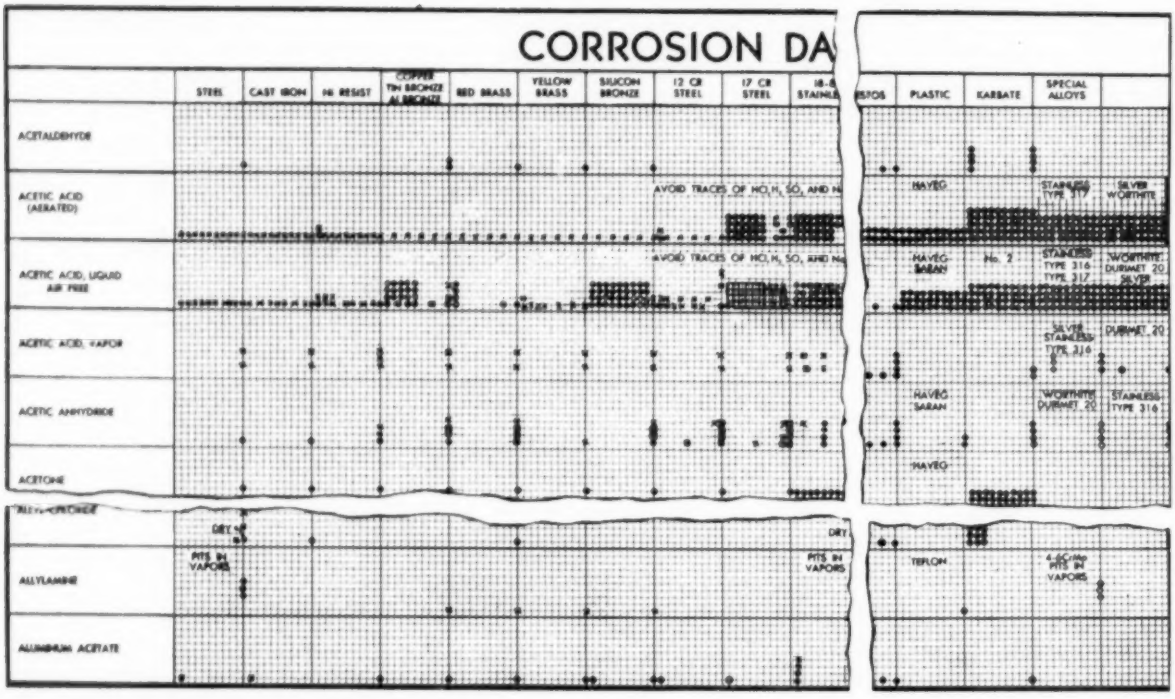
A decrease in overall total anticipated spending by the reporting companies amounts to 1.8%—$1,534,443,000 in 1954 as against an estimated $1,562,359,000 in 1953 for all four categories of the industry.

A survey made in October by the McGraw-Hill Department of Economics showed that the U.S. petroleum industry as a whole plans to spend $2,757,000,000 in 1954 for new plant and equipment as compared to an estimated $2,824,000,000 in 1953, a decrease of 2%. This compares with an 8% decrease for all domestic manufacturing industries.

"The petroleum industry plans expenditures close to the 1953 level," survey stated. "All divisions . . . evidently expect to maintain a high level of spending.

Petroleum, automobiles, machinery, and electrical machinery are holding within 10% of plans reported to McGraw-Hill in February, 1953.

Decline in over-all manufacturers' investment plans "is mostly related to the completion of defense expansion programs. There is no evidence of widespread cutbacks in anticipation of a business recession," McGraw-Hill said.



CORROSION RESISTANCE DATA for 52 materials of construction vs. 450 corrosive substances is accumulated in this form by Shell Development Co. Explanation of chart use is on facing page

FIGHT CORROSION!

Profit from Your Own Experience

Here's a three-point program for broadening corrosion prevention

THE widening field of Corrosion Engineering in petroleum processing plants now includes more than merely repairing the damage to an individual heat exchanger, valve, line or vessel.

Engineering staffs charged with responsibility for saving their companies part of the heavy losses they now suffer from corrosion are taking on broader functions. The scope of their work today includes:

1—Setting up methods to correlate experience data more completely, since it is this data which can provide the remedy for individual cases of corrosion damage.

2—Extending the work of inspecting metals to give a more complete check on the various types as they go into service.

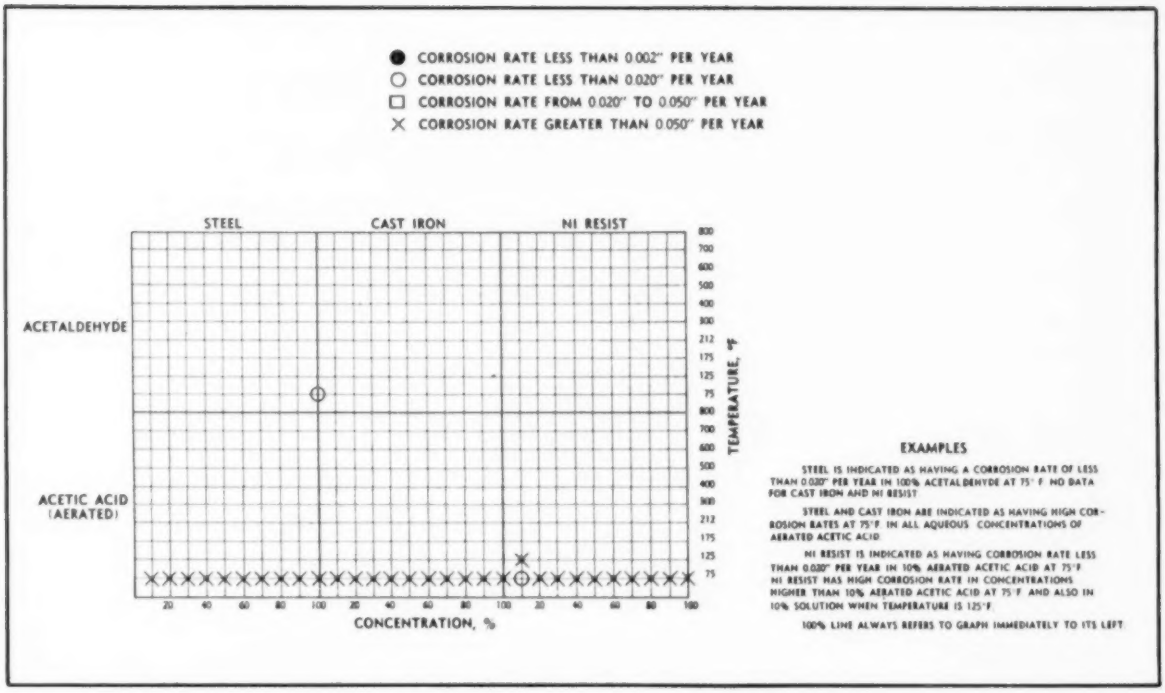
3—Aiding the design engineers, both in the company plants and with outside contractors, in avoiding corrosion potentialities when new units are planned.

Better Correlation of Corrosion Data

The importance of expanding work in the first area—better correlation of corrosion data—stems from the fact that about all the plants have to go on at present in solving specific corrosion problems is to try something that has worked in similar cases before. There is little if any basic data on the mechanism of corrosion, or other fundamental principles, that can be brought to bear on a specific problem.

"Every large oil company has the answer to most corrosion problems it experiences in its plants right in its own files," said the superintendent of one plant. "The great trouble is that no one knows it is there. Consequently, the same mistakes are repeated in repairing damage."

The most progressive method yet worked up to correlate the corrosion resistance of various materials to contaminants, in the opinion of many authorities, has been devised by the Shell Development Co. for the benefit of its


● CORROSION RATE LESS THAN 0.002" PER YEAR
○ CORROSION RATE LESS THAN 0.020" PER YEAR
□ CORROSION RATE FROM 0.020" TO 0.050" PER YEAR
× CORROSION RATE GREATER THAN 0.050" PER YEAR
STEEL
CAST IRON
NI RESIST
ACETALDEHYDE
ACETIC ACID (AERATED)
TEMPERATURE, °F
CONCENTRATION, %
EXAMPLES
STEEL IS INDICATED AS HAVING A CORROSION RATE OF LESS THAN 0.020" PER YEAR IN 100% ACETALDEHYDE AT 75° F. NO DATA FOR CAST IRON AND NI RESIST.
STEEL AND CAST IRON ARE INDICATED AS HAVING HIGH CORROSION RATES AT 75°F. IN ALL AQUEOUS CONCENTRATIONS OF AERATED ACETIC ACID.
NI RESIST IS INDICATED AS HAVING CORROSION RATE LESS THAN 0.020" PER YEAR IN 10% AERATED ACETIC ACID AT 75°F. NI RESIST HAS HIGH CORROSION RATE IN CONCENTRATIONS HIGHER THAN 10% AERATED ACETIC ACID AT 75°F. AND ALSO IN 10% SOLUTION WHEN TEMPERATURE IS 125°F.
100% LINE ALWAYS REFERS TO GRAPH IMMEDIATELY TO ITS LEFT

HOW TO USE Shell's corrosion data charts. Example above is from upper left corner of sample chart on facing page. As additional experience is recorded, more code symbols are entered on the charts

plant corrosion engineering group.

The data are summarized in a group of charts to show what materials may be practicable for handling a large number of corrosive substances. The present edition of Shell's corrosion data lists 52 materials, including iron and steel, steel alloys, brass, bronze, copper, aluminum, and a few plastics. Their degree of resistance is shown for over 450 corrosive substances. A section of one of the charts is shown above, together with an explanation of how to use them. Full size of each chart is 11 x 17 inches.

In the makeup of the graphs, of which there are several for convenience in handling, the 52 materials are listed across the top and the corrosives are listed alphabetically down the sides. The form of graph provides for showing, for each material and each corrosive, the corrosion resistance for 10 ranges of temperature and also for showing the resistance at varying degrees of concentration of the corrosive. Temperature ranges are in ° F. at 75, 125, 175, 212, 300, and on up to 800 in 100° increments.

Four code symbols have been adopted to indicate the degree of resistance of the materials to the corrosives, as shown in the illustration. One rating is where the material is practically inert to the corrosive; another indicates that the material would be economically feasible and require a minimum of maintenance. A third classification indicates a corrosion rate of between 0.020 and 0.050 IPY (inches of penetration per year) with the particular contaminant. The fourth rating is where the rate of deterioration is too high to merit consideration for use.

The Shell corrosion data graphs, the work of G. A. Nelson, a company metallurgist, are kept up to date at headquarters. Every few years revised copies are sent out to the plants as a guide to be used in the selection of materials for various applications.

Compiling of corrosion data in a standard form is a principal duty of the corrosion group in another company. This is found to aid in taking off data for a general correlating report. In each refinery of this company one man, generally an engineer or metallurgist, is named to head up the corrosion protection work. In small plants, this individual might also have other duties such as metal inspection, water treating, or some related subject. He alone is responsible for the metals protection work.

One of his duties is to pass on to headquarters—also on a standardized form—reports on unusual corrosion difficulties encountered or specific treatments used.

A coordinating corrosion engineer in the company's central engineering department receives all the data from individual plants. He passes on at once to other plants any particular problems with which he thinks they might be concerned. This coordinating engineer also prepares for his company an annual report on corrosion-fighting activities based upon the reports from individual plants.

The annual report includes a review of the sulfur content of the crude processed in the company's plants during the year. It discusses corrosion conditions encountered in any recently installed processing unit, and reviews unusual difficulties encountered as reported by the individual plants. It also discusses progress in the general overall programs of protection and prevention. This annual report is indexed and cross-referenced, so that the individual reports can be easily consulted.

Copies of this report are distributed as follows: to the men heading up corrosion work in each plant; to the company vice president for manufacturing; and to others who are interested. Cost data has not been included in this company's reports to date. The men in charge of the work feel that the corrosion information is handled in such a way that plant and overall company management is always aware of the problem and its cost.

In another company, a somewhat less formal method of communication is employed. Whenever new or unusual metals deterioration problems are

worked on in any specific plant, the corrosion engineer there makes a trip to other refineries in the company to explain and demonstrate just how his own plant has met and perhaps solved the difficulty. Also, about every six months one plant corrosion engineer tours all the other plants to learn first-hand what their problems have been.

Wider Application of Metal Inspection

In the new programs for corrosion protection being used by some refining companies, the activities of the metal inspectors have been broadened to include the identification of metals in materials and new equipment coming into the plant as well as inspection of metals in use in existing processing equipment.

This phase of the work is aided by the fact there are available such means as spot tests, spark tests, magnetic tests and others which can be used for rapid, accurate identification of the types of metal, eliminating the need to resort to more involved and time-consuming laboratory analyses.

The spot test identifies the steel through the reaction of the surface to a drop of some specific reagent—usually one of the acids. The spark test classifies steels according to their chemical composition as indicated by visual examination of the sparks thrown off when a small sample of the material is held against a high-speed grinding wheel. Another technique is spectrographic analysis, and many refinery laboratories use such equipment.

These rapid tests have permitted many refineries to enlarge the duties of their corrosion engineering groups to include examination of materials and equipment coming into the plant, even though they were purchased on specification, unless the type of material is given in certified mill reports.

For example: rings, sleeves, and other parts in pumps are tested to determine whether they are actually of the material specified, particularly where the equipment is to go into service under corrosive conditions. Such items as new bolts are tested for type of steel, because their deterioration in service could cause serious damage—for instance, in flanges on high pressure vessels and equipment.

The type of material in the warehouse equipment is also recorded, so that it is known what type of service it will stand. In this way it is possible to avoid damage which could result from a pump or heat exchanger replacement part being put into a service for which it was not suited.

Materials removed from equipment because of failure are also tested in some plants to determine if they are actually of the composition shown on the equipment record.

Aiding in Design of New Process Units

With some companies the corrosion protection group is assigned an important part when a new unit is to be built, either by the plant force or by an outside contractor.

First, the corrosion engineer is asked to determine whether the proposed unit may encounter any new corrosion problems, either through the nature of the stock to be charged, chemicals to be used, or through operating temperatures or pressures out of line with previous experience.

Where it is determined that such conditions of deterioration of metals may be found, then the corrosion engineering group is given the task of assembling and correlating all available data bearing on the new conditions, from the company's records, published literature or other sources. Where reports of failures are found the causes of failure are examined.

The corrosion engineering staff is also asked to present its ideas as to whether changes in the new units processing steps would be more economical for avoiding the corrosive conditions than the installation of corrosion-resistant alloys.

With this company the corrosion engineers also serve in the design of new units where corrosive conditions may be encountered. They dig out whatever data is available from the company records on the most economical corrosion-resistant materials. Studies were made over a long period on the economics of using both 5 and 7% chrome tubes in thermal cracking furnaces. It was found that the 7% chrome tubes, while costing more, gave a sufficiently longer life to prove more economical. In any new furnace to operate under similar conditions, 7% tubes are specified.

The corrosion engineers with this company advise outside contractors on the corrosion allowance to be included for vessels or other equipment. Although the contractor makes an arbitrary allowance based on their general experience, the plant protection group advises if conditions in their refinery are such that a different allowance is advisable.

"Corrosion Costs $250 Million a Year"—API

CORROSION may be costing petroleum refiners as much as a quarter of a billion dollars a year, according to John W. Newton, vice president of the Division of Refining, American Petroleum Institute. The estimate is based on a study now being made by an API subcommittee on corrosion headed by E. Q. Camp, Humble Oil & Refining Co., Baytown, Texas.

A corrosion cost estimate of $220,000,000, or about 9¢ per bbl. of crude processed, was made by PETROLEUM PROCESSING and reported in the last issue (November, pp. 1685-1688).

Mr. Newton, who is also vice president of Magnolia Petroleum Co., Beaumont, Texas, said that current company records do not provide better than an approximate loss figure. He explained that many losses are indirect and others are concealed frequently in the statistics of general maintenance.

One of the objectives of the present study by the API corrosion group is to work out more reasonable methods for determining losses due to corrosion.

The preliminary loss estimate also does not take into consideration any decrease in revenue resulting from maintenance shutdowns or production shutoffs. Such losses are significant only when refining capacity is pressed by product demand.

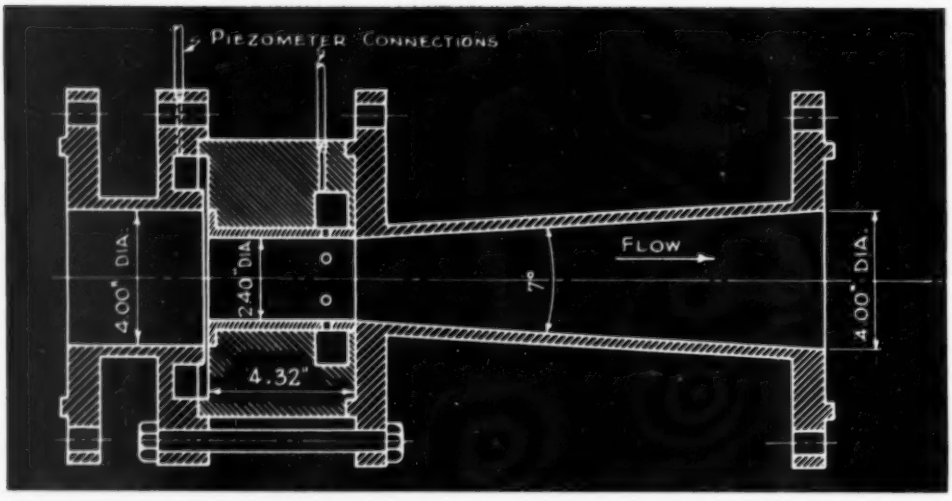
At the present time, Mr. Newton pointed out, refining capacity is adequate to permit shutdowns for maintenance and repairs without penalizing product output. But in the event of a national emergency, the situation would be different because maximum output would be essential and shutdowns would cut off valuable production.

"Effective corrosion prevention in refineries would make a substantial contribution to national defense, and would reduce the amount of steel required to produce essential petroleum products," Mr. Newton concluded.

BIGGEST ORTHOFLOW fluid catalytic cracker in the world is going up at Atlantic Refining Co.'s Philadelphia plant. The unit, under construction by M. W. Kellogg Co., will have a total reactor throughout of 45,000 b/d. It's one of 11 Orthoflow units either completed or under construction which have been designed by Kellogg since 1951. A new alkylation plant is also being built at Atlantic's Philadelphia location.

DOWNTIME SLASH will result from installation of a new electrical distribution system at Shell Develop- Co.'s Emeryville, Calif., research center. New 1 ton, 12,000-volt circuit breaker, part of the system, is being demonstrated by T. G. O'Brien, electrical foreman.

CHECKING TEST results with Clifford G. Harriz (right), Houdry Process Corp., are Kazuo Kurosawa (left) and Satoshi Kobayashi. They're here to study Houdriflow cat-cracking, will return to Japan to supervise operation of Daikyo Oil Co.'s 4200 b/d cat-cracker at Yokkaichi.



FINAL DESIGN in development of new flow measuring device

Here's a New Flow Meter Design

Differential pressure device provides high accuracy with low construction cost and easy installation

By ANDRE L. JORISSEN, SANDER L. WISE, and JAMES M. SYMONS, Cornell University, Ithaca, N. Y.

A NEW flow measuring device of high accuracy yet simple and inexpensive construction is now in the process of development—the cylindrical nozzle with conical diffuser.

As the name implies, and as is indicated in the illustrations above, the device consists of a cylindrical nozzle placed in the line in the same manner as the more common orifice plate, and with a conical diffuser immediately downstream from the nozzle.

The cylindrical nozzle itself has been known for some time to be capable of maintaining a constant coefficient of discharge at Reynolds Numbers lower than standard pressure differential producing devices.

The addition of a conical diffuser to the nozzle reduces the non-recoverable head loss by approximately 50% for this type of differential producer.

It is believed that the new device represents a significant contribution to the field of flow metering. It will be useful for metering fluids more viscous than water, such as heavy oils and some liquid chemicals.

It should offer improvement in flow measurement where a reduction in the error of measurement is important to the economy of the operation, be it simple transportation measurement of flow between distant points or measurement of quantities of liquid transferred from one part of a plant to another.

It will also be important in the measurement of water flows at low velocity and in small pipes and where totaling and recording mechanisms are used to furnish permanent records.

Not only will improved accuracy of measurement be possible but it has the further advantage that it is simple in construction, low in comparative cost, easy to install, and will require small space for installation.

Basic Flow Measurement

Fluid flows in a confined system may be measured by introducing a differential-producing device in the line. Such a device usually consists of a constriction in the line plus pressure measuring equipment. Measurements of the differential pressure produced are usually taken at two points in the device—at the entrance and at the constricted section. This differential is a function of the velocity (and quantity) of flow and, by calculations or automatic measuring devices, can be converted into flow data.

The variation of the coefficient of discharge of ordinary pressure-difference flow metering devices, such as the orifice, nozzle, and Venturi Tube, is a source of difficulty in the use of these devices with indicating, totalizing and recording mechanisms, under certain conditions which produce low values of Reynolds Number. (Reynolds Number is the ratio of inertia forces to viscous forces, and combines velocity, length and kinematic viscosity of the fluid. It is a pure number—i.e., without dimension—and is expressed in this article as a function of pipe diameters, according to standard practice.)

In the range of low Reynolds Numbers, tolerances and errors in coefficients of discharge are larger than at higher ranges.[3,4] The limit for this non-constancy range is arbitrarily defined as the value of Reynolds Number at which the coefficient varies by 0.5% of its constant value. This is called the "limit of constancy."

For example, the limit of constancy of a regular Herschel-type Venturi Tube is at a Reynolds Number value of about 100,000; the deviation below this value is such that the decrease from a constant value for the coefficient is about 1.5% at a Reynolds Number of about 50,000 and 2.5% at a Reynolds Number of 20,000.[2]

Because of the difficulties attributed

to this variation of the coefficient, numerous investigations have been devoted to new types of devices which may be expected to exhibit a lower limit of constancy than the standard devices. Several research organizations, including the International Organization for Standardization and the Research Committee on Fluid Meters of the ASME, have sponsored research on the problem in recent years.

Among the devices considered have been double bevel orifices, orifices in series, cylindrical nozzles, round edge orifices, etc. Some success was found in the use of round edge and double bevel orifices with diameter ratios of 0.50 and 0.35, respectively. Until recently, however, scanty information made impossible the serious consideration of any of the other devices.[4]

The cylindrical nozzle has been of particular interest to researchers. An extensive series of tests conducted about 1938 by Koennecke indicated excellent behavior of the discharge coefficient in the range of low Reynolds Numbers. Koennecke's results show a practically constant coefficient for Reynolds Numbers as low as 3000 for some of the diameter ratios studied.[3] In addition to this behavior, the cylindrical nozzle has the additional advantage of simple and inexpensive construction.

These potential advantages of the device supplied the stimulus for an extensive project which was begun in 1950 under the senior author, who at that time was a professor at Pennsylvania State College. The first phase of the project consisted largely of checking Koennecke's results, and determining the optimum lengths of the nozzles for a given diameter ratio.

The second stage of the work was conducted at Cornell University, also under the senior author, and consisted of adding a conical diffuser immediately downstream from the nozzle with the objective of reducing the non-recoverable head loss.[5] A third phase of the program is now being conducted and includes several refining features of the device in preparation for actual commercial production.

It is anticipated that the end result of the project will be a simple type of Venturi Tube having a limit of constancy of less than 20,000, and a non-recoverable head loss which compares favorably with other commercial flow measuring devices.

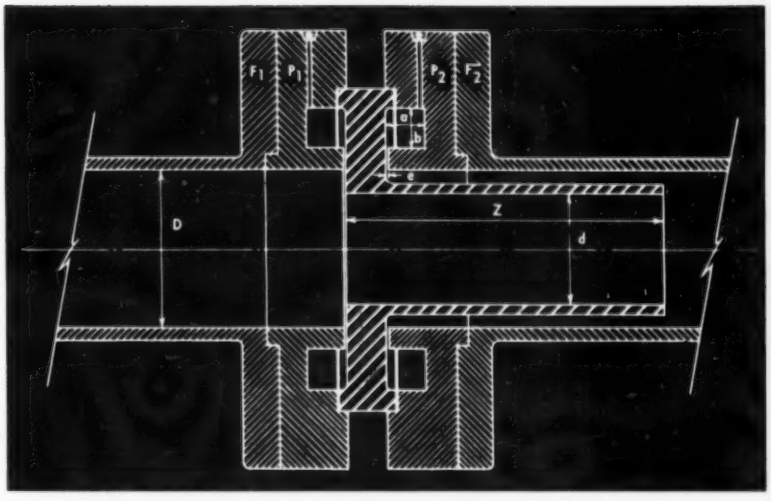


FIG. 1—Cross section of the nozzle during first phase of the test work

Installation and Test Procedure

In the first phase of the project five nozzles of various dimensions were studied in a four-inch pipeline. The nozzles and the test sections of the pipe were constructed of brass. The nozzle edges were sharpened according to ISA specifications, and rigid standards were imposed upon the entire assembly. Each nozzle was first studied with a maximum length (z), which was subsequently shortened for the determination of the optimum length ratio. Fig. 1 shows the cross-section of the nozzle installation and indicates the relation of diameter to length as well as the location of the piezometer connections, P_1 and P_2. Fig. 2 shows the installation arrangement of the test equipment at the Hydraulics Laboratory of Cornell University.

In the measurement of differential pressure three devices were employed: an air-water manometer, a water-mercury manometer, and a point gage differential micromanometer. The choice of measuring device depended on the order of magnitude of the head measurements but connections were such that each manometer could be used individually or simultaneously with one or both of the others.

Discharge measurements were made by means of a calibrated volumetric tank into which the flow could be

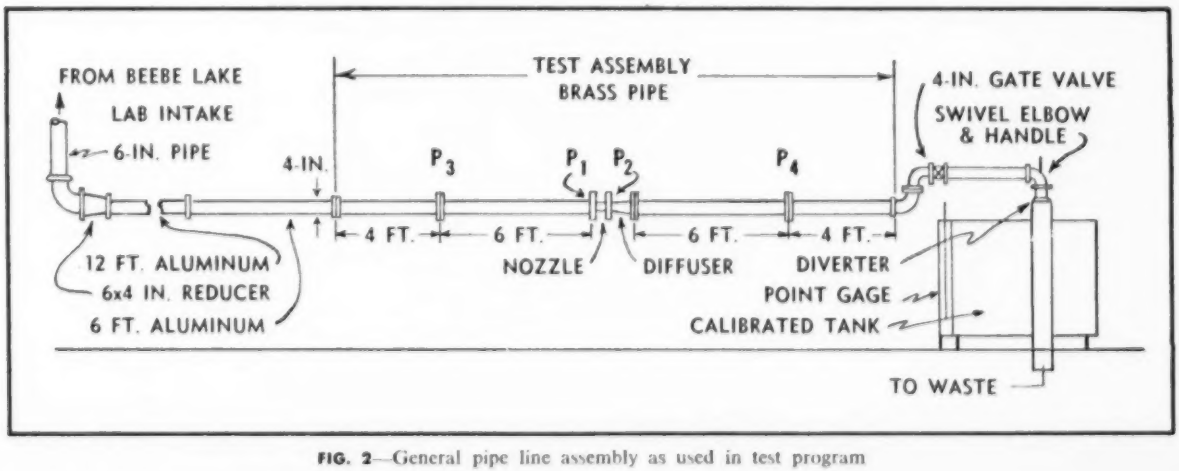


FIG. 2—General pipe line assembly as used in test program

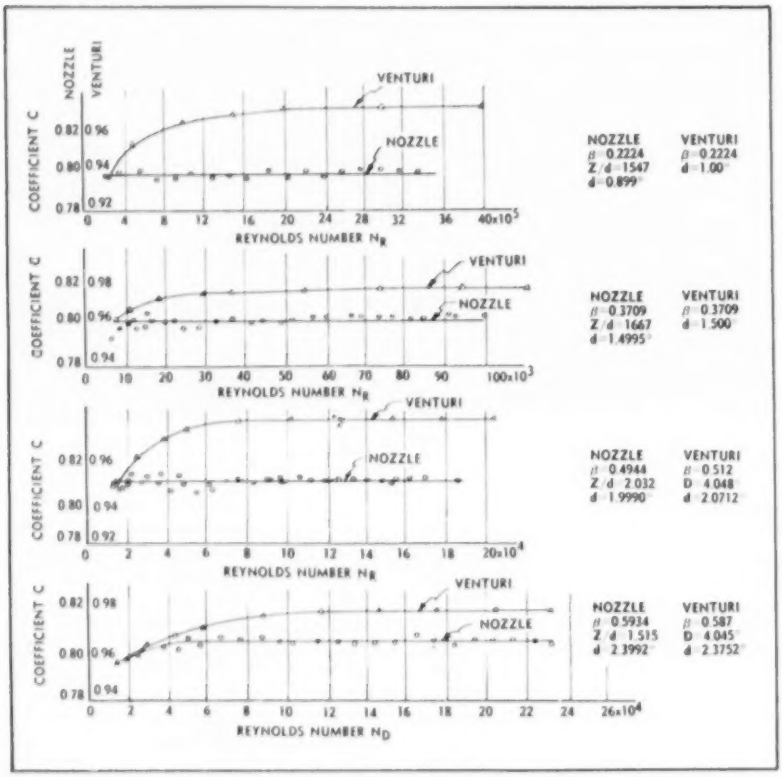


FIG. 3—Comparison of limit of constancy of coefficient of discharge for cylindrical nozzle and Venturi tube

diverted at will. An electric timing device was connected to the diverter, and the precision of time measurements was 0.01 sec. It was estimated that the standard error on the mean of the discharge measurements was 0.10%.

For each of the nozzles tested, 10 to 25 runs were made at various rates of flow. Extreme care was taken to secure steady conditions and to insure against defects in the installation.

The difference in pressure used for the computation of the discharge coefficient was that measured between piezometer rings P_1 and P_2 (Fig. 1). The non-recoverable head loss was considered to be the differential of piezometers P_3 and P_4 (Fig. 2) minus the ordinary friction losses in the test section of pipe. In order to compute this friction head loss, preliminary tests were run to determine the value of the friction factor (f) in the Darcy-Weisbach equation:

$$h_f = f\frac{L}{D}\frac{V^2}{2g}$$

In the second phase of the work two nozzles were used. Both had a diameter ratio equal to 0.593 with slightly different length ratios, (z/d). Each was tested completely with and without the conical diffuser. The total angle of divergence of the diffuser used was seven degrees (7°).

Since this portion of the work was conducted at the Cornell University Hydraulics Laboratory, it was necessary to make several modifications of the original test installation. These modifications were all of a minor nature and included a difference in water source, change in length of approach, and an improvement in the connection of the timing circuit. In order to compare the results obtained in the new installation with those obtained in the Pennsylvania State College tests, one complete test was run on one of the nozzles used in the first phase and the variation on the mean of the discharge coefficient was found to be 0.05%.[5]

(It has been the purpose of the authors to present only a brief account of the installation and procedure employed in the various portions of the project. Detailed information is readily available in the references.)[3, 4, 5]

Table 1—Optimum Values of z/d[3, 4]

$(R_D)_n$ Limit of Constancy	β Diameter Ratio	z/d Length Ratio	λ Head Loss Ratio in %
2200	0.2224	1.5	93.7
7000	0.3709	1.7	83.0
15000	0.4944	2.0	71.1
25,000	0.5934	1.5	59.8
25000-70000	0.6928	...	46.5*

*Approximate

Discussion and Conclusions

For each nozzle the first series of tests was run at dimensions close to the optimum presented by Koennecke. Excellent agreement with his results was obtained. Subsequently, each nozzle was shortened in order to improve the optimum proportions. The values tabulated as optimum are those which exhibited the smallest non-recoverable head losses. These are shown in Table 1.

No optimum value could be assigned to β=0.6928 since the coefficient of discharge varied radically as the z/d ratio became smaller. A possible explanation of this variation might be that for the largest value of the ratio, the fluid expands from the vena contracta to the pipeline cross section in two steps, first to the exit section of the nozzle and then to the pipeline diameter. As the z/d ratio is reduced, however, the second stage of the expansion is eliminated; that is, the fluid expands directly from the vena contracta to the pipeline diameter. This change may cause the variation in the discharge coefficient.[4]

The results of the first phase of the project indicate a much lower limit of constancy than that obtained with standard devices, as shown in Fig. 3. The pressure losses, however, were quite high, and judgment of the suitability of the cylindrical nozzle for practical application was deferred until the results of the second part of the project were available for consideration.

The second phase of the project substantiated the anticipated results. It was shown that the addition of a conical diffuser had no effect on the discharge coefficient or on the maximum deviation from the mean coefficient, but it did show beneficial effects

Table 2—Mean Values of Discharge Coefficient[5]

	C Mean	Max. % Deviation
Nozzle A	0.817	0.3
Nozzle A with Diffuser	0.817	0.2
Nozzle B	0.822	0.4
Nozzle B with Diffuser	0.822	0.5

on the non-recoverable loss in head. Table 2 shows the comparison of the nozzles with and without diffusers.

It can be seen from Table 2 that in the range of Reynolds Number tested (20,000 to 250,000), the maximum deviation from the mean was 0.5% indicating a limit of constancy at least as low as 20,000. These results serve to establish further the validity of the results obtained in the first phase of the work.

The addition of the conical diffuser produced gratifying results in reducing the non-recoverable head losses by about 50%. This improvement is illustrated by the data in Table 3.

The reduction noted in the pressure losses makes the cylindrical nozzle with conical diffuser a practical device which compares favorably with the other metering devices now in use. It should be noted that the head loss ratio (λ) and the head loss coefficient (K) were nearly constant and are not functions of the Reynolds Number, at least over the range tested. The relative order of magnitude of head loss ratio of various discharge measuring devices is shown in Table 4.

It appears that these results are sufficient to require serious consideration of the cylindrical nozzle as an important addition to the field of flow metering. However, a third phase of the project is being conducted at Cornell University, to determine whether additional refinements might further reduce the head losses, and to study the effect of locations of the piezometer connections on the constancy of the coefficient.[5] The first study in this phase is to determine the effect on the discharge coefficient of upstream piezometer connections at various locations, ranging from the present corner taps to connections at one half and one diameter upstream.

A second portion of the work will concern a study of the effect of a slight beveling on the upstream edge of the nozzle throat in an attempt to secure further reductions in the non-recoverable head loss. Also, the effect of roughness of the approach pipe on the effectiveness of the instrument will be determined.

Table 3—Effect of Conical Diffuser on Non-Recoverable Head Loss

	Mean Head Loss Coefficient, K	Head Loss Ratio, λ, Mean %
Nozzle A	6.30	60.0
Nozzle A with Diffuser	3.40	32.0
Nozzle B	6.15	59.0
Nozzle B with Diffuser	3.20	31.0

Table 4—Comparison of Head Loss Ratio for Discharge Measuring Devices

	Head Loss Ratio, λ, %
Cylindrical Nozzle A	60
Nozzle A with Diffuser	32
Orifice	55
Flow Nozzle (ASME long radius)	54
Herschel Venturi Tube	11

Acknowledgment

The authors wish to express their sincere appreciation to Builders-Providence, Inc., who sponsored this research project and who will market the device under the name Builders S-J (Schlag-Jorissen) Flow Tube, for their permission to use the results of these several investigations.

Nomenclature

R_D = Reynolds Number
$(R_D)_a$ = Limit of Constancy
d = Nozzle diameter
D = Pipe diameter
$\beta = d/D$ = Diameter ratio
z = Length of nozzle
z/d = Length ratio
h = Total head loss across test assembly $(P_3 - P_4)$
$\triangle h$ = Differential head across nozzle $(P_1 - P_2)$
h_f = Friction head loss
h_l = Non-recoverable head loss $= h - h_f$
$\lambda = h_l/\triangle h$ = Head Loss Ratio expressed as per cent
K = Head loss coefficient
C = Coefficient of discharge

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(5) "A Flow Metering Device for Discharge Measurements at Low Reynolds Numbers," Master's Thesis, by Clifford S. Coates, Cornell University, June, 1952.

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Meet the Authors

Dr. Jorissen

Mr. Wise

Mr. Symons

ANDRE L. Jorissen is professor of civil engineering and head of the department of hydraulics and hydraulic engineering, Cornell University.

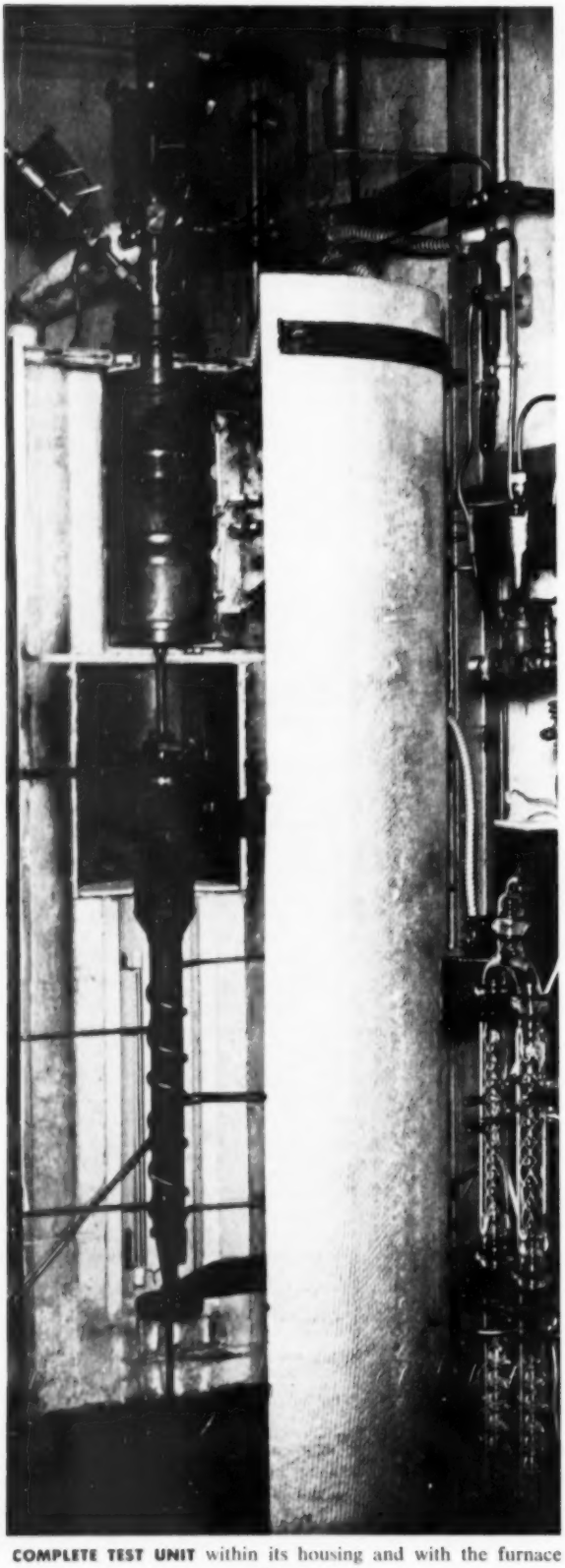
A native of Belgium, he received a civil engineering degree from the University of Liege in 1936, a master's dgree from M.I.T. in 1937, and his Sc. D. from Liege in 1949. He did considerable work in fluid mechanics in Belgium between 1935 and 1947, chiefly at the University of Liege.

From 1947 to 1948, Dr. Jorissen was scientific adviser for the Laboratoire Central D'Hydraulique, Paris. In 1949, he came to this country as a member of the civil engineering faculty at The Pennsylvania State College, where he remained until 1951. He has been associated with Cornell since that time. He has had 36 publications on flow measurement, flow processes, hydrodynamics, and related subjects.

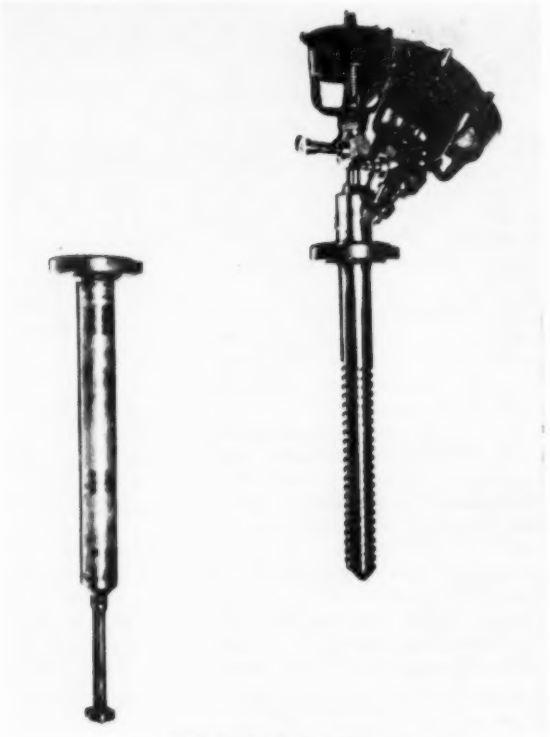
Sander L. Wise is working toward a B. in C. E. from Cornell in 1954. Born in Baltimore in 1933, Mr. Wise is also registered at the Cornell Law School with an aim toward a career combining engineering and law.

James M. Symons was born in 1931 in Champaign, Ill. He will graduate from Cornell in 1954 also in civil engineering, and plans graduate work in the field of sanitary engineering.

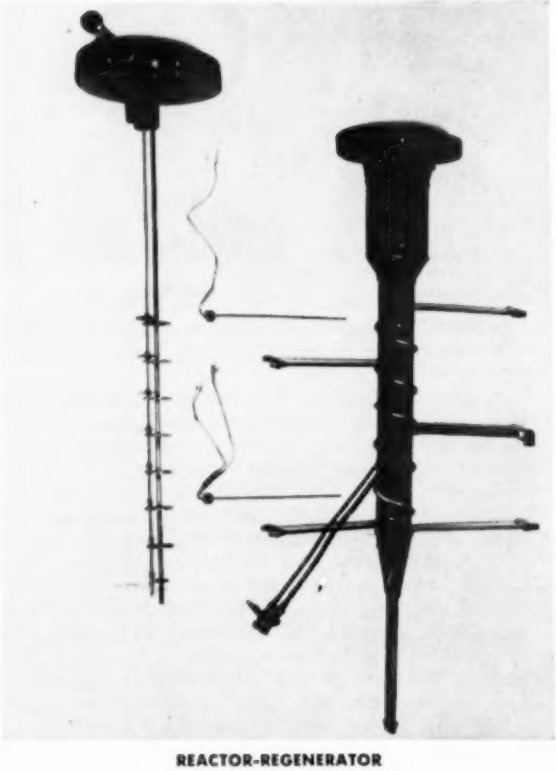
Automatic Catalyst Testing Unit



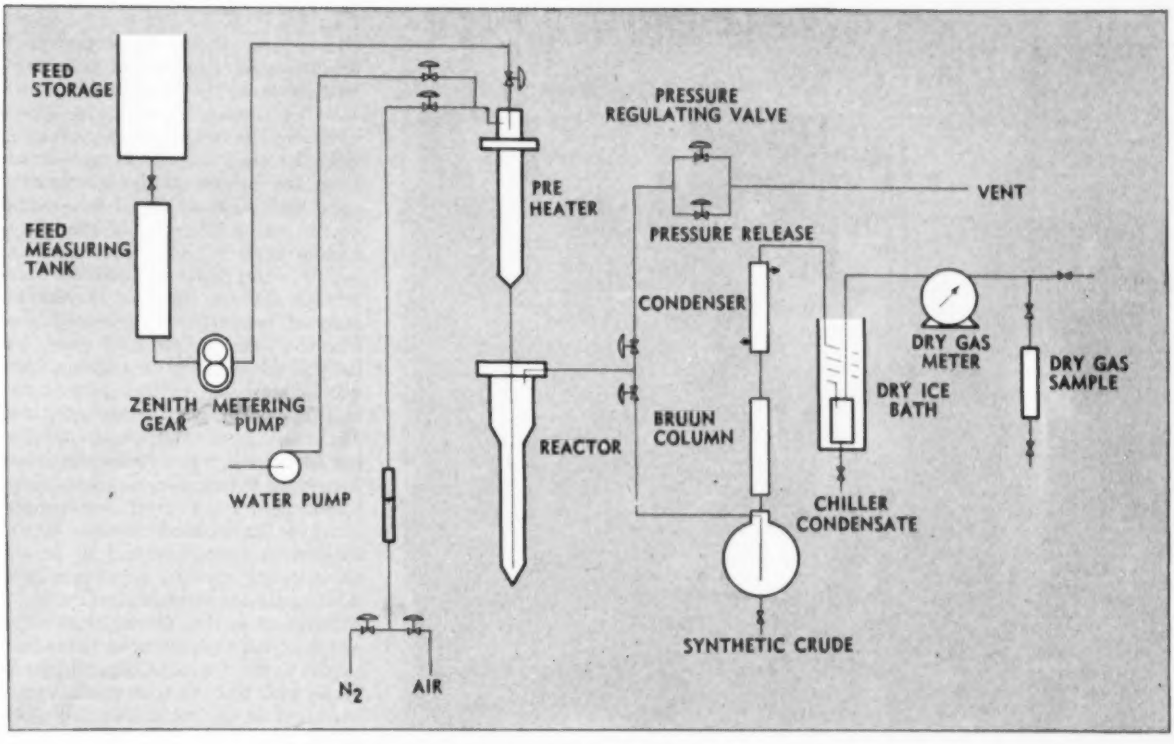
COMPLETE TEST UNIT within its housing and with the furnace envelope open



PREHEATER AND SHELL



REACTOR-REGENERATOR



SCHEMATIC FLOW DIAGRAM of the fluidized fixed bed aging system

Evaluation of Cracking Catalysts

How to obtain performance data with an automatic fluidized fixed-bed aging unit

By C. K. VILAND
Tide Water Associated Oil Co.

THE path to higher profits from catalytic cracking for gasoline production frequently has a stumbling block in the form of difficulties in finding a practicable method of testing experimental cracking catalysts.

A useful laboratory tool for studying aging of catalysts was recently described in the literature[1] and several similar units are known to be in operation. This bench-scale, automatically-controlled catalytic cracker, as used in the Avon Research Laboratories of Tide Water Associated Oil, was found to have some limitations in usefulness which have been corrected principally by redesign of the reactor to permit a wider range of operating conditions.[2]

Redesign was prompted by two major limitations imposed by use of pelleted catalyst:

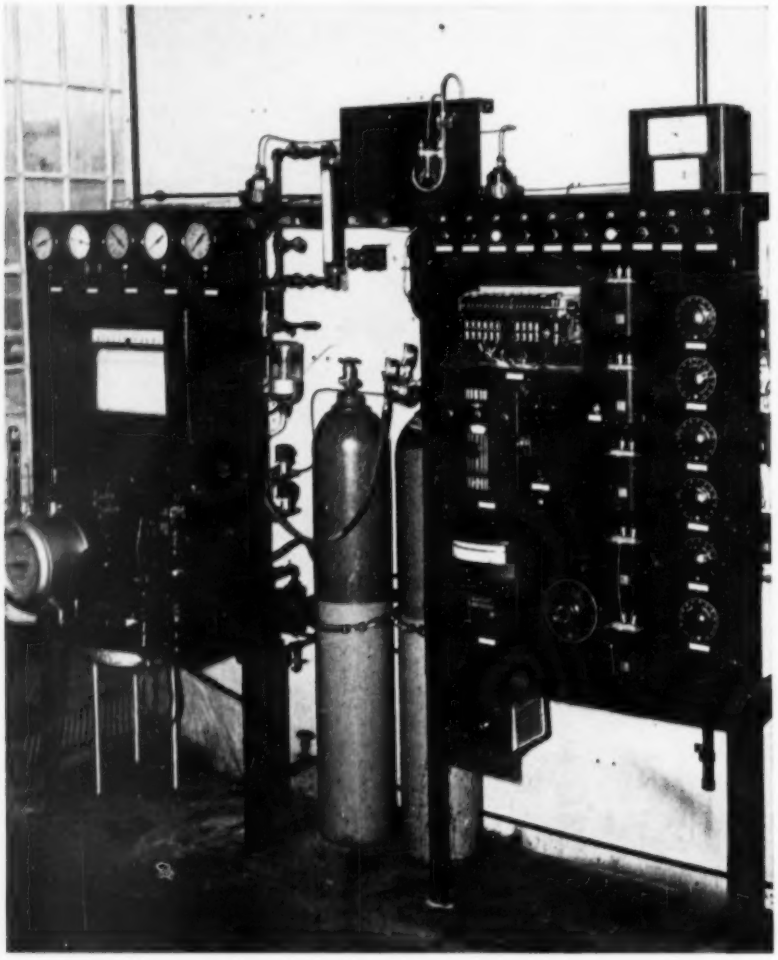
1—Relatively low reactor temperatures must be employed to permit burning off of catalyst deposits without reaching excessive regeneration temperatures.

2—Varying degrees of compression powdered catalyst to form pellets change the characteristics of cracking catalysts.

Both of these limitations effect product distribution adversely compared to normal fluid catalytic cracking. Results of research on the original unit indicated trends of relative product distribution only, rather than predicting actual yields, as can now be done.

The newly designed unit retains the desirable characteristics of the older unit: completely automatic 24-hr operation; use of automatic shut down; safety devices, etc. By use of auxiliary heaters and coolers, reaction and regeneration temperatures can be controlled at any desired level. Stripping is now accomplished by steam rather than nitrogen to better simulate commercial aging of catalysts.

Development work first involved making only the simplest mechanical changes to the original apparatus. A reactor was set up in glass to study the fluidized bed action. Glass cylinders of various sizes and shapes were used to find the most desirable dimensions, and to determine the best use of baffles to prevent channeling. A reactor with a 1½-in diameter and 20-in. bed depth seemed best. In this reactor a minimum vapor velocity of 0.05 ft./sec. was required to fluidize the bed.



CONTROL PANEL for the aging unit, mounted on the housing, proves to be relatively complex

From this preliminary work a new reactor was designed and constructed of stainless steel, together with an improved preheater unit. Necessary modifications were also made to the controls and other appurtenances. The original cycle timer controls flow during the various cycles by, opening and closing in sequence magnetic and air motor diaphragm valves, by starting and stopping the oil feed pump and a water pump used to make steam.

Studies made of the Avon commercial catalytic cracker showed the catalyst makes an average round trip through the unit every 27 min. when circulation rate is 26 t/min. This allows for a 3-min. contact time between catalyst and oil in the reactor, 2 min. steam stripping, 19 min. regeneration period, and 3 min. for transferring the catalyst between the vessels.

A fixed-bed unit in which the reaction, stripping, and regeneration all take place in the same vessel must necessarily operate on a slightly different time schedule than a unit in which each part of the process takes place in a different vessel. However, an effort was made to approach the time schedule used in the commercial unit.

A 30 min. cycle was used in which the reaction time is 3 min., steam stripping 6 min., and regeneration 13 min. The remaining 8 min. are used to purge the air from the vessel after regeneration and to cool the unit down to the proper reaction temperature before the feed pump starts.

It was found that the approximately 2 gm. of carbon laid-down on the catalyst each cycle during reaction did not provide sufficient heat when burned during regeneration to raise the temperature of the catalyst higher than 1025° F. To age catalyst in the testing unit similar to regeneration conditions in commercial fluid catalytic cracking, at temperatures up to 1135° F. during regeneration, it was necessary to arrange for the cycle timer to short out the thermocouples from the reactor to the temperature controllers so that the full heat would be on during first part of the regeneration cycle.

It was also discovered that the catalyst bed did not return to the desired reaction temperature of 965° F. before the time for the feed cycle. To correct this situation a stainless steel cooling coil was wound around the reactor and air passed through it for 5½ min., 2 min. of which were at the end of the regeneration cycle and 3½ min. during the nitrogen purge cycle. Before an even temperature could be maintained throughout the catalyst bed, the coil had to be divided in half and the air to each section regulated separately.

Outcome of this development work was a control sequence as follows:

An Eagle Signal Corp. Program Timer with 10 cams controls the cyclic operation of the unit. The following shows the length of each cycle and what each cam does:

Unit	Time (in min.)	Cam No.*
Charge Pump	0:00- 3:00	3
Water Pump-Water Valve Product Valve	0:00- 9:00	4
Auxiliary Heat Bottom of Reactor	9:00-11:30	2
Auxiliary Heat Top of Reactor	9:00-16:00	1
Regenerator Air Valve	9:00-22:00	5
Exhaust Valve-Gas (Air and N_2) Valve	9:00-30:00	7
Cooling Air Solenoid Valves	20:00-25:30	9
Nitrogen Solenoid Valve and Pressure Release Valve	22:00-30:00	8

* Cams 6 & 10 not in use

Essential equipment of the fluidized fixed-bed catalyst aging unit include two feed tanks (one for storage and the other for measuring charge to the unit), a feed charging pump, a water pump used for dispersion steam and steam stripping, a feed preheater, a combined reactor-regenerator, a synthetic crude dehydrator and receiver, wet gas condenser, and a wet gas meter, in addition to the equipment for automatic control. All storage vessels have sufficient capacity to permit the unit to operate unattended for 30 hours.

Charge Pumps—The Zenith Products Co. gear pump with a variable speed transmission provides an extremely accurate control on rates of 7 to 30 cc./min. of feed, equivalent

to weight hourly space velocities of 2 to 8.

A feed valve was specially constructed to reduce the hold-up of oil and to drain completely at end of each feed cycle.

Steam used for dispersion during the feed and stripping cycles is produced by pumping distilled water at rates from 9.5 to 33 cc./hr. into the feed preheater where it is turned into steam. It was found that somewhat more steam is required to strip the oil vapors from the catalyst than is normally used commercially. The water pump is a positive displacement long piston device holding 800 cc. of water. Various rates are obtained by changing the belt on the pulleys.

Preheater—The oil feed to the unit is raised from 140 to 650° F. in the preheater. The preheater is a stainless steel plug, 21 5/16 in. long, machined with a screw thread. This plug fits into a 1½-in stainless steel pipe. Oil, water, air, and nitrogen, during the various cycles, flow down through the center of the plug in a ½-in. hole and down the surface of the preheater through the 3/16-in. square screw thread 107 inches long. The flow then passes from the end of the preheater into a ¼-in. extra heavy stainless steel pipe which is connected to the reactor. The plug and stainless steel pipe shell were machined with a taper of 1/16-in. to the foot to facilitate the removal of the plug from the shell.

The preheater assembly fits into an aluminum bronze block 6-in. in diameter by 15-in. long. The block is electrically heated by a 1000 watt banded heater. A Leeds and Northrup "Electromax" temperature controller with a 12-in. thermohm located in the block is used to control the block temperature.

Reactor regenerator assembly is 29 5/8 inches long and is constructed of stainless steel. The lower section, in which the catalyst bed is located, is made of 1½-in. pipe 15 7/8-in long with a 4½-in. 20° cone bottom. There are two removable thermocouple wells in this section. Each well has two thermocouples—one for controlling and one for recording. It was found necessary to control both the top and bottom of the catalyst bed in order to maintain a uniform temperature. Located near the center of the bed is a catalyst sample line.

The upper part of the reactor-regenerator is used as a dilute phase catalyst drop-out section and is made of 3-in. pipe 4½ in. long with a 125 lb. tongue and groove welding neck flange 2¾ in. long.

On the top of this vessel is a blind flange in which is screwed a ¼-in. stainless steel tube 28 in. long. Eight baffle grids are tack welded to this tube every 2 in. beginning at the bottom. Screwed into the blind flange at the top of the vessel is a porous stainless steel filter which allows only minute traces of catalyst to carry through with the vapors. Filter material is fritted stainless steel grade F.

Furnace Envelope—The preheater and reactor-regenerator assemblies are enclosed in a 17-in. transite pipe 60 in. long, split in half and hinged to facilitate inspection. This insulated furnace envelope is divided into three sections:

1—The upper section which surrounds the aluminum bronze block preheater.

2—Below this is the transfer line section which has a split monel shell on which are mounted four 250-watt strip heaters. A thermocouple located in the air space in this section is used to regulate the temperature at 965° F., or whatever required.

3—In the bottom section 24 in. long is located a 2000-watt, nichrome heater. Attached to this refractory is an auxiliary 2000-watt electric heater.

Holding the temperature uniform throughout the catalyst bed was a most difficult problem to solve. At first the heat was supplied by one 2000-watt heater wound in the grooves of the refractory. Control was from a thermocouple in the lower section of the reactor. After trying several methods of control, the top and bottom temperatures were still 25° F. apart during the reaction cycle.

For this reason the auxiliary 2000-watt heater was installed and is divided into two sections. The lower section is controlled by temperature controller from a thermocouple in the lower part of the bed. The upper section is controlled by a temperature controller from a thermocouple in the upper part of the bed.

Good control was not obtained until he original 2000-watt refractory heater was put on a powerstat and connected with the cycle timer to come on during the feed cycle. The additional heater together with temperature control of the top and bottom of the bed results in a mixmum 5° F. spread in the bed temperatures during reaction.

Other cycles also presented problems of temperature control. It was found that the temperature of the top of the bed wanted to climb during the steam stripping cycle so a by-pass was installed on the upper cooling air coil and a small amount of air continually bled in. This step solved the temperature control during this cycle.

The problem of raising the temperature of the catalyst bed to 1135° F. during regeneration was worked out by using two cams on the cycle timer to short out the thermocouples from the upper and lower sections of the catalyst bed and allow the temperature controllers to turn on the full heat at the beginning of the regeneration cycle. Cam No. 1 shorts out the thermocouple from the top of the bed for 7 min. and Cam No. 2 shorts out the thermocouple from the bottom of the bed for 2½ min.

Vapors leaving the reactor-regenerator vessel pass through either of two Minneapolis Honeywell "Gradutrol" Air Motor Valves depending on the cycle. In order to reduce the possibility of oil contamination in the flue gas and improve the experimental weight recovery of products, these

Meet the Author

Mr. Viland

C. K. Viland, general supervisor, research and development department. Tide Water Associated Oil Co., Avon, Calif., joined Tide Water's Western Division's predecessor, the Associated Oil Co., after his graduation in 1929 from the Colorado School of Mines. He served successively as a chemist, chemical engineer, and supervisor of development before moving in to this present position.

Mr. Viland's major field of activity has been related to gasoline manufacture. He has written a number of articles on this subject, two papers on catalytic cracking pilot plants having been published previously in Petroleum Processing. Mr. Viland is a member of the American Chemical Society and a registered chemical engineer.

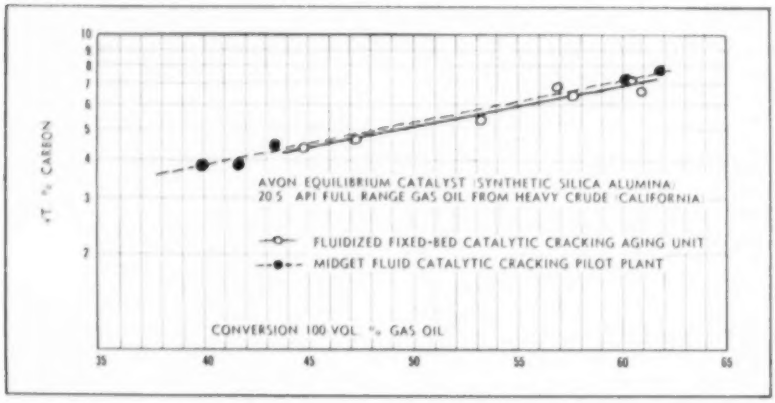

% CARBON
AVON EQUILIBRIUM CATALYST (SYNTHETIC SILICA ALUMINA)
20.5 API FULL RANGE GAS OIL FROM HEAVY CRUDE (CALIFORNIA)
FLUIDIZED FIXED-BED CATALYTIC CRACKING AGING UNIT
MIDGET FLUID CATALYTIC CRACKING PILOT PLANT
CONVERSION 100 VOL. % GAS OIL

FIG. 1—Carbon-vs-conversion curves; synthetic silica alumina catalyst and 20.5 API full range gas oil heavy crude

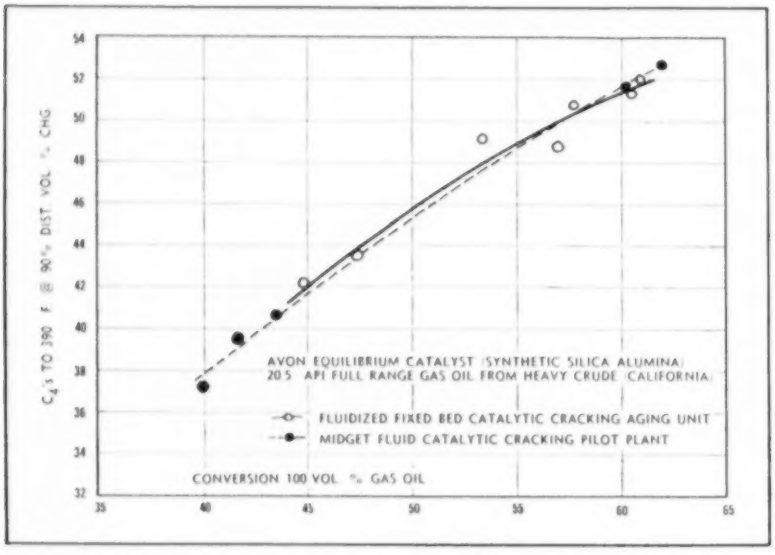

C4's TO 390 F @ 90% DIST. VOL. % CHG
AVON EQUILIBRIUM CATALYST (SYNTHETIC SILICA ALUMINA)
20.5 API FULL RANGE GAS OIL FROM HEAVY CRUDE (CALIFORNIA)
FLUIDIZED FIXED BED CATALYTIC CRACKING AGING UNIT
MIDGET FLUID CATALYTIC CRACKING PILOT PLANT
CONVERSION 100 VOL. % GAS OIL

FIG. 2—Vol-% change-vs-conversion; same conditions as in curves in Fig. 1

two valves were located as close as possible to the reactor-regenerator.

Since the vapors normally leave this vessel at temperatures of 965° to 1135° F. it was necessary to install a short water cooler between these valves and the outlet of the vessel. Fortunately the rates are very low and considerable heat loss takes place. Even at that, the vapors are in the neighborhood of 400° F. when they contact the seats of these valves. For tight closure because of tiny particles of catalyst it was found necessary to use some form of rubber discs in these valves. Investigation of a number of materials showed silicone rubber to be the most satisfactory.

Regeneration of the catalyst can be done at pressures of 5 to 40 psi. The flue gas leaving the regenerator through the upper of the two valves at the outlet of the regenerator passes through a regulating valve controlled by a Mason-Neilan pressure regulator. During the cycle when the amount of carbon deposited on the catalyst is being determined, the flue gases pass through a bellows type gas meter into a rubber balloon. At the end of the cycle a sample of the flue gas is transferred to a gas bomb and analyzed on an Orsat analyzer.

Several safety devices are used, as follows:

1—Pressure Manometer: The unit is protected from excessive pressures by two bursting discs. When one of these discs blows out, the released vapors or liquid force the mercury in a manometer to close an electrical circuit. This circuit energizes a relay that shuts off the main power supply. A 200 psi. disc is in the air and nitrogen line, and a 60 psi. disc is in the feed line. These discs fit into 2-in. unions and are connected to the vent line as well as to the pressure manometer.

2—Dehydrator Manometer: A connection on the product line directly before the dehydrator leads to another mercury manometer. It is possible for the $CaCl_2$ drier or wet gas condenser to plug up and raise the back pressure on the glass dehydrator to a point where it will leak in the ball joints or even break. To prevent this condition, the mercury manometer closes an electrical circuit when the pressure reaches 6 ps. A reset relay is then energized which shuts off the power to all parts of the unit except the temperature recorder. Simultaneously with the shutting down of the unit, a solenoid valve opens and releases the pressure on the dehydrator to a vent line. The relay can be reset by stopping the temperature recorder and starting it again.

3—High Temperature Limit Switch: Should something happen to cause a temperature higher than 1175° F. within the unit a limit switch on the temperature recorder shuts down the unit.

4—Fire Protection: All parts of the unit, with the exception of a wet gas meter, instruments on the panel board, and a wet gas condenser, are located inside a fire-proof transite housing four feet wide, eight feet long, and ten feet high.

Spaced around the ceiling are four spray nozzles through which CO_2 gas is discharged into the room when an Edison thermostat reaches a temperature of 185° F. This thermostat completes an electric circuit which sets off a detonator type valve in the head of a CO_2 cylinder outside the room. The sudden rush of the CO_2 gas through the line to the nozzle operates two pressure switches: one of which shuts the pilot plant down by shutting off the electric power, and the other rings an alarm in the near-by Physical Laboratory, where men are on duty 24 hrs. a day.

5—Power Failure: Should a momentary power failure of less than 30 seconds occur, an electronic time delay device restores energy to put the unit back into operation. If longer, the equipment remains inoperative until started in the normal manner.

Catalyst Preparation: Catalyst to be tested is first screened to 60-250 mesh to remove the fines and then calcined at 975° F. for 5 hrs. in a muffle fur-

nace. The catalyst is then removed from the furnace and cooled in a desiccator. Into a graduated cylinder that is being agitated on a Boerner shaking table, 385 cc of the cooled catalyst is measured and immediately weighed. It is then sucked into the reactor through the catalyst sample line by pulling a slight vacuum on the outlet of the reactor.

The calcining step in preparing the catalyst for testing puts all samples on an equal basis as far as weight is concerned since adsorbed water and carbon are removed. The weight of the catalyst is needed to calculate the weight hourly space velocity, catalyst to oil ratio, carbon lay-down, etc.

Operating Procedure: After the catalyst is in the reactor and the unit is up to operating temperature, the unit is tested for leaks by building up the pressure with air and shutting off the valves. With the feed tanks filled and up to temperature, the charging pump is adjusted for the desired feed rate.

Next, the water pump is filled and set to give the proper amount of steam for stripping and dispersion. An empty flask receiver is attached to the bottom of the dehydrator and the heating mantle fitted around it. With water running through the condensers and coolers and dry ice in the wet gas condenser, the unit is now ready to start.

The cycle timer is turned to the nitrogen purge cycle and the timer motor started. At the beginning of this cycle the exhaust and pressure release valves in the flue gas line are opened by Cam No. 7 and 8 respectively. This releases the pressure from the reactor to the atmosphere.

Simultaneously, the nitrogen solenoid valve and gas valve (at the top of the preheater) are opened by these same cams. This allows nitrogen to flow through the reactor at a rate of 0.06 cfm. (set by a rotameter). The nitrogen is used to clear the reactor of air before the feed is started. After purging for 8 mins., the pressure release, exhaust, gas valve, and nitrogen solenoid valves are closed.

Cam No. 3 starts the feed pump, opens the feed valve (at the top of the preheater) and Cam No. 4 opens the product valve. The oil is pumped from the calibrated feed reservoir up the heated feed line and down through the preheater into the reactor.

At the same time the feed is started, Cam No. 4 also starts the water pump and opens the water valve (at the top of the preheater). The water is turned to steam in the preheater and helps to disperse the oil through the catalyst in the reactor. The product vapors and steam pass out through the product valve into the synthetic crude receiver.

Water in the hydrocarbon gases leaving the receiver is stripped out in the dehydrator and $CaCl_2$ drier before they enter the wet gas condenser.

Most of the butanes and some of the pentanes and heavier fractions that are carried over with the lighter gases are trapped in the wet gas condenser. The dry gases from the wet gas condenser are measured in a Precision Scientific Co. Wet Test Gas Meter and then pass on out the vent line.

After the oil has been charged for 3 mins. the feed pump and feed valve are closed by Cam No. 3. The water pump remains on for another 6 mins. to strip the catalyst of oil vapors. At the end of this time, Cam No. 4 stops the water pump, water valve, and product valve.

The regeneration cycle is started by Cams No. 5 and 7. These cams open the air, gas, and exhaust valves. Air at a rate of 0.102 cfm (measured by a rotameter) passes down through the preheater into the catalyst.

Simultaneously with the starting of the regeneration cycle the auxiliary heat to the top and bottom of the reactor comes on to raise the temperature to 1135° F. This is controlled by Cams No. 1 and 2 which short out the thermocouples to the top and bottom temperature controllers on the reactors respectively. Cam No. 1 allows the full heat to stay on the upper heating coil for 7 mins. while Cam No. 2 allows the full heat to stay on the lower heating coil for only 2½ mins.

The air continues to flow into the catalyst and out through a pressure regulating valve held at 10 psi by a Mason Neilan pressure regulator. Two minutes before the air goes off, Cam No. 9 opens the cooling air that passes through the split cooling coil wound around the reactor-regenerator.

This cam opens two solenoid valves which allow a regulated amount of cooling air to each coil. In this way the bed is cooled uniformly to the desired temperature before reaction takes place again. After the regeneration air is on for 13 mins., Cam No. 5 closes the air valve.

When the regeneration air goes off, the nitrogen purge is started again and the cycle completed except that the cooling air in the coils remains on during the first 3½ mins. of the nitrogen purge cycle.

Laboratory Analyses of the synthetic crude, chilled condensate, dry gas, and catalyst samples are made in the Control Laboratory.

A standard column distillation is run on the synthetic crude to determine the vol.-pct. of (C_5's to 390° F. at the 90% distilled) gasoline and the vol.-pct. of catalytic gas oil boiling above the gasoline. A small sample of the synthetic crude is also run on a low temperature Podbielniak column to determine the amount of butanes remaining in the synthetic crude.

A portion of the chilled condensate is run on the low temperature Podbielniak column and mass spectrometer.

The dry gas is analyzed on the mass spectrometer.

Carbon analyses are run on catalyst samples by the "Leco" method.

The flue gas from the regeneration cycle is also analyzed to check carbon burning rates.

Desired inspection tests are run on the gasoline and gas oil fractions.

Correlation: While the fluidized fixed-bed unit is designed primarily to test and age fresh catalysts under simulated plant conditions, it is important to know its correlation with commercial operations as to the product distribution obtained.

Using a standard reference 20.5° API charge stock from California crudes and plant equilibrium catalyst, the correlation between the automatic fixed-bed aging unit and a fluid catalytic cracking pilot plant which duplicates commercial yields is shown graphically in Figs. 1 and 2.

These portray coke and gasoline yields at varying conversions obtained by changing space velocity through the catalyst, but holding other conditions constant. The reacator temperature was held at 965° F. in both units, regeneration was at 1125° F. and stripping steam was used for each cycle in the amount of 35 lb./1000 lb. of catalyst. Dry gas, also C_3 and C_4 fraction yields are also essentially the same.

The unit is particularly adapted to studying changes in product distribution as a catalyst ages with use under simulated commercial conditions. It is also well suited to catalyst poisoning studies. Sample requirements are low because of its size, and manpower requirements are small because of the automatic control features which permit unattended operation over a major portion of the time.

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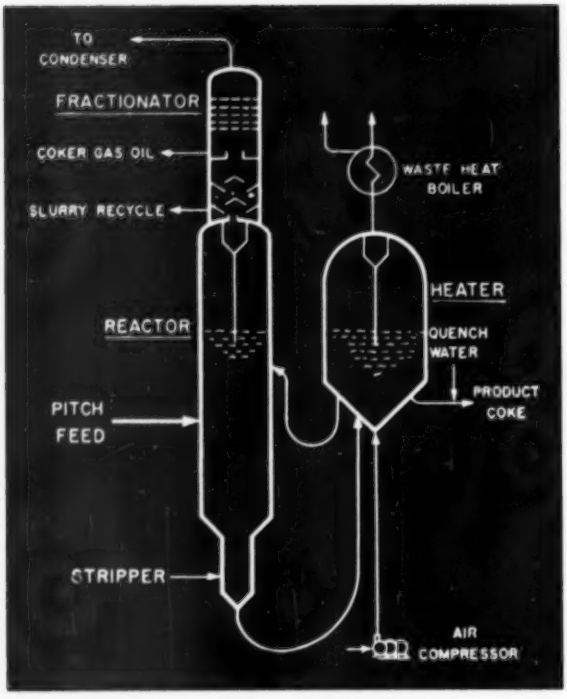


FLUID COKING UNIT—schematic flow diagram

Two New Coking Processes

Here are facts and figures on two new continuous coking processes, on which reports were presented at the 33rd annual meeting of the American Petroleum Institute in Chicago last month.

One method, called "fluid coking," is the latest application of the fluidized-solids technique. Standard Oil Development Co. is the originator and licensor. It was described in the Sept. issue of this magazine, p. 1316. Further details on operation and products appear on this and the next page.

The other method, continuous contact coking, is a Lummus Co. development. It was described earlier in the July, 1949, issue of this magazine, p. 769. A report on the performance of a commercial unit at Shamrock Oil & Gas Corp., Sunray, Texas, appears in this issue, pp. 1882-1883.

The Fluid Coking Process

THE fluid coking process, the latest application of the fluidized-solids technique, employs no catalyst. It depends on a circulating stream of finely divided coke particles to furnish heat and on a large amount of surface to accomplish the coking reaction.

In appearance it is like a Fluid catalytic cracker. It has a burner vessel and a reaction vessel and the necessary stand pipes and transfer lines to circulate fluidized coke. The coke is formed continuously in the process, and it is partly burned to supply heat.

The bulk of the coke is withdrawn from the system as a by-product which, besides its fuel value, may have interesting applications in such uses as carbon electrodes in the aluminum industry.

The basic function of the fluid coke is that of a heat carrier. Rapid heat transfer is obtained by virtue of the fine particle size of the fluid coke. As the feed is injected into the reactor, it, therefore, heated up very quickly.

At reactor temperatures the viscosity of the residuum is low so that its distribution over the surface of the fluidized solids is rapid and uniform. In the reaction zone the heavier fractions of the feed stock are only partly vaporized, most of the cracking reaction being effected in the liquid phase. However, the more volatile products evaporate rapidly, so that products consist of dry overhead vapor and dry coke.

Pilot-plant operation on a 100-b/d scale has demonstrated successfully the process on very heavy residua from Elk Basin, from Hawkins, and from South Louisiana crudes.

Standard Oil Development Co. is making the process available under license. Plans for building three Fluid cokers have been announced by affiliates of Standard Oil Co. (N. J.). The first is for Carter Oil Co., Billings, Montana, and is a 3800-b/d unit. It is scheduled for operation in late 1954. Esso Standard Oil Co. plans to follow about a year later with a 10,000-b/d unit at Baltimore and a 21,000-b/d unit at Baton Rouge.

Typical yields from operations in the 100-b/d pilot plant on three feed stocks are shown in Table 1. The South Louisiana mixture is a light sweet blend; whereas Elk Basin and Hawkins are much heavier sour crudes.

These data are for "once-through" operation. However, most commercial plants would be run with recycle to 100% conversion of the material boiling above the gas oil. In the examples shown, this gas oil was cut at a 1015-F still vapor temperature, and this produced a feed suitable for catalytic cracking.

However, it is not implied that 1015-F is necessarily the optimum cut point. This point will depend upon feed stock and operating conditions. Also, it is emphasized that the pilot plant was run primarily to obtain operating and engineering data. Hence, the yields shown in Table 1 are not optimum.

To estimate ultimate yields with bottoms recycle to extinction, successive-pass coking has been conducted in the laboratory pilot plants on the 1015-F bottoms from once-through coking. From these data, ultimate yields for favorable coking conditions have been calculated for two feeds and are shown in Table 2.

The residuum was converted from fuel value to 76 to 85 vol.-% of gasoline and gas oil and 24 to 36 wt.-% of fuel products. It will be noted that the coke yields are close to the Conradson carbon of the original feed.

This is typical of the data on a wide variety of feeds, and is another way in

which fluid coking differs from delayed coking. In the latter process, coke yields are closer to twice the feed Conradson carbon.

As already pointed out, the choice of the 1015-F cut point is somewhat arbitrary. The optimum end point may be higher or lower, depending on the composition of the original residuum with respect to metals—nickel, vanadium, iron—which are undesirable contaminants of cracking catalysts.

Of course, a similar situation exists in the primary distillation of the crude in vacuum towers to produce a high end-point virgin gas oil for catalytic cracking.

In this primary vacuum distillation, as in fluid coking, trace quantities of very high-boiling volatile metal compounds—nickel, vanadium, iron—are taken overhead when high end-point gas oils are produced, and the quantity of such trace catalyst poisons depends both upon the cut point and upon the composition of the crude.

In the preparation of feed stocks for catalytic cracking, it is generally economical to go to the highest end point of gas oil consistent with tolerable quantities of these catalyst contaminants.

The coke produced in this process has some interesting and unique properties. Its fine, but uniform, particle size makes it easily handled as a fluid but, nevertheless, it is a clean, dustless solid. Chemical and physical properties are given in Table 3.

The low hydrogen and volatile matter in the coke indicate the calcination which takes place in the burner vessel. The coke is expected to find its way into the already established markets for petroleum cokes. It can be transported as a fluid material by pipe lines, gondola cars, barges, and other carriers.

In many refinery situations, especially when catalytic cracking equipment is not available; the opportunity exists for a very simple combination of fluid coking and thermal cracking. In this case, the coking is conducted once-through—which somewhat shrinks the size of the coking unit—and the total coker overhead minus the gasoline fraction may be fed directly to a thermal cracking unit.

The preceding article is a condensation of the paper "Fluid Coking of Residua," presented at the 33rd annual meeting of the American Petroleum Institute, Nov. 9, in Chicago, by A. Voorhies, Jr., Esso Laboratories, Esso Standard Oil Co., Baton Rouge, La., and H. Z. Martin, Esso Laboratories, Standard Oil Development Co., Linden, N. J.

Table 1—100-b/d Plant, Once-through Operations on Three Vacuum Residua

Feed Stock Source	South Louisiana Mixture	Elk Basin	Hawkins Batch 1
Feed Inspections:			
Gravity, °API	13.2	2.5	4.5
Conradson carbon, wt.-%	14.0	30	23.2
Ash, wt.-%	0.23	0.11	0.07
Sulfur, wt.-%	0.9	3.5	4.5
Vis., Say. Furol at 275° F., sec.	18	393	342
5% pt., °F.	Cracks	1000	902
Correlated Yields on 1st Pass:			
C_5 to 430-F. FVT* naphtha, vol.-%	12.5	12	15
430 to 1015-F. FVT gas oil, vol.-%	42.5	29	36.5
1015+F. bottoms, vol.-%	35	35	27
C_4, vol.-%	2	2	2.5
C_3 & lighter, gas, wt.-%	6.5	6.5	7
Coke, wt.-%	8	23	19
Product Quality:			
C_5 to 430-F.: gravity, °API	52.5	52	53
C_5 to 430-F.: sulfur, wt.-%	0.1	0.3	0.7
C_5 to 430-F.: res. Oct. without TEL	78.5	78.5	78
Gas oil: gravity, °API	23.5	19	16.5
Gas oil: sulfur, wt.-%	0.4	2.8	3.7
Gas oil: Con. carbon, wt.-%	1.4	2.4	2.1
Bottoms: gravity, °API	13	0.7	1.0
Bottoms: Con. carbon, wt.-%	14	30	26

* FVT denotes Final Vapor Temperature.

Table 2—Estimated Ultimate Yields from Two Vacuum Residua

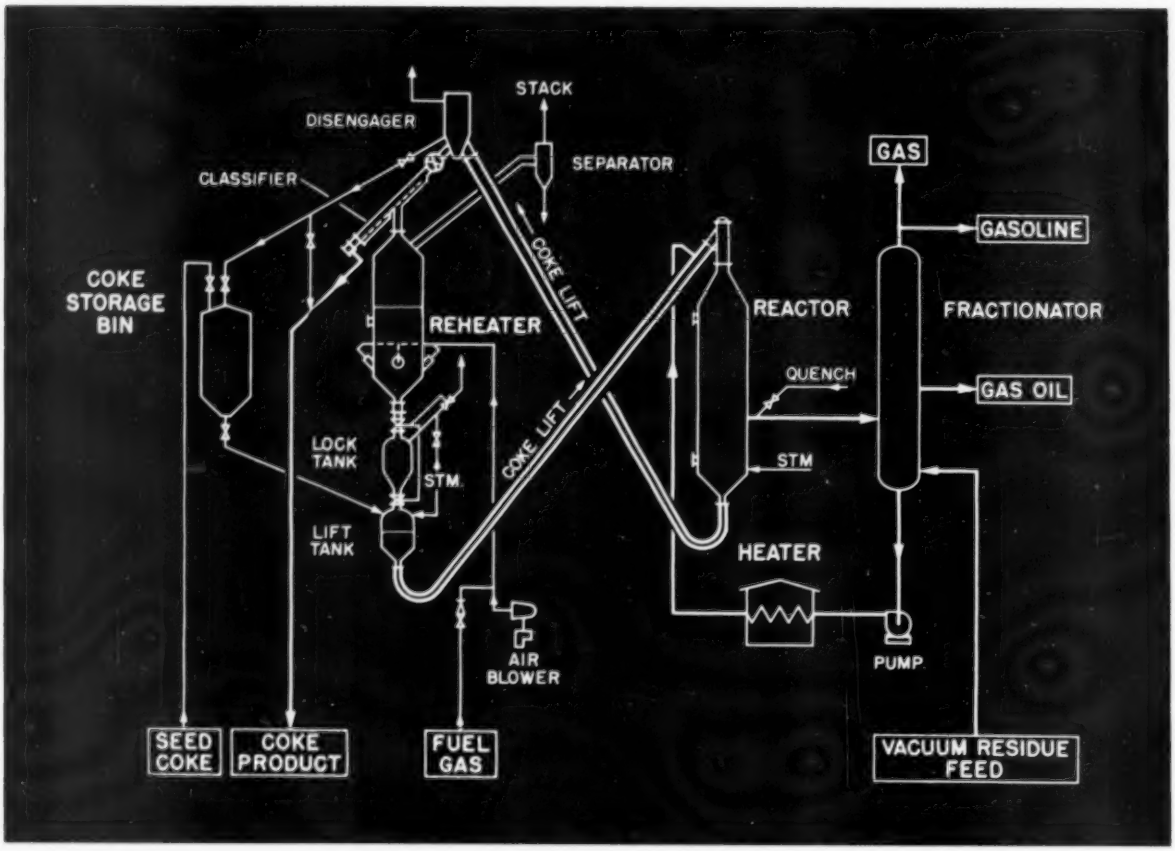
Feed Stock Source	South Louisiana Mixture	Hawkins Batch 2
Feed Inspections:		
Gravity, °API	13.2	4.0
Conradson carbon, wt.-%	14	24
Ash, wt.-%	0.23	0.07
Sulfur, wt.-%	0.9	4.5
Ultimate Yields, % on Feed:		
C_5 to 430-F. FVT* naphtha, vol.-%	21	21
430-F. to 1015-F. FVT gas oil, vol.-%	61	52
1015-F. bottoms, vol.-%	0	0
C_4, vol.-%	3	3
C_3 and lighter gas, wt.-%	8	9
Coke (total), wt.-%	16	27
430-F to 1015-F. FVT Quality:		
Gravity, °API	23	17
50% point, °F.	750	800

* FVT denotes Final Vapor Temperature.

Table 3—Quality of Product Coke from 100-b/d Fluid Coking Pilot Plant

Vacuum Residuum Crude Source	South Louisiana (partly desalted)	Elk Basin	Hawkins
Carbon, wt.-%	92.5	88.6	88.3
Hydrogen, wt.-%	1.6	1.8	1.9
Sulfur,* wt.-%	1.4	6.4	7.0
Volatile matter, wt.-%			
At 2100° F.	0.6	1.3	0.9
At 1742 °F. (950° C.)		5.3	5.0
Ash,* wt.-% at 1100° F.	2.8	0.7	0.7
Ash components, as metal in coke:			
Vanadium, wt.-%	0.01	0.17	0.02
Nickel, wt.-%	0.01	0.06	0.01
Iron, wt.-%	0.11	0.08	0.04

* Values for ash and sulfur are higher than will be obtained commercially for two reasons: 1) a greater percentage of the coke made is burned in the pilot plant than is anticipated for commercial operation; and 2) the bottoms recycled commercially will have a lower ash-to-coke ratio than the portion of the feed converted in the 1-pass pilot plant operation.



CONTINUOUS CONTACT COKING—flow diagram of 1000 b/d unit

Continuous Contact Coking

Table 1—Properties of Charge Stock, Yields, and Product Specifications

(Charge is Texas Panhandle Vacuum Bottoms)

Charge Stock:	
Gravity, °API	18.9
Material boiling under 950°F, vol.-%	2.0
Sulfur, wt.-%	0.6
Conradson Carbon, wt.-%	11.7
Vis., Say. Furol at 122° F., sec.	1227
Characterization factor, UOP	12.3
% on crude	10.0
Operating Conditions:	
Oil inlet, °F.	690
Coke inlet, °F.	990
Coke outlet, °F.	915
Average reactor, °F.	955
Reactor pressure, psig.	36
Mass Lift:	
Coke circulation, ton/hr.	75
Lift-tank pressure, psig.	130
Lift steam, lb./hr.	650
Yield, wt.—%:	
C_3 and lighter	14.5
C_4 to 400-F gasoline	22.0
Gas oil	51.0
Coke	12.5

Inventory coke—screen analysis:	
Wt.-% retained on Screen (Tyler):	
0.25-in. mesh (1)	49.0
0.187-in. mesh (4)	21.4
0.131-in. mesh (6)	13.8
0.096-in. mesh (8)	12.6
0.065-in. mesh (12)	1.8
0.039-in. mesh (18)	0.9
Pan	0.5
Product Inspection:	
Gas Analysis, wt.-%	
Methane and lighter	18.1
Ethylene	11.1
Ethane	15.5
Propylene	25.4
Propane	3.3
Butane	13.0
Butylene	13.6
	100.0
Olefins, %	50.1
Gasoline:	
Gravity, °API	54.4
I.B.P., °F.	136
10%, °F.	202
50%, °F.	281
90%, °F.	362
E.P., °F.	395
Res. Oct.,	
without TEL	76.5
with 3 cc./gal. TEL	83.0
Characterization factor, UOP	11.9
Aniline point, °F.	99.0
Sulfur, %	0.14
Gas Oil:	
Gravity, °API	27.5
Vac. distillation at 760 mm.:	
I.B.P., °F.	400
10%, °F.	500
50%, °F.	760
90%, °F.	1050
Characterization factor, UOP	11.85
Coke:	
Bulk density, lb./cu.ft.	64.0
Volatile matter, wt-%	3.7
Ash, wt.-%	1.0
Sulfur, wt.-%	0.6

PERFORMANCE of the first commercial continuous contact coking unit—a 1000-b/d plant at the McKee refinery of Shamrock Oil & Gas Corp., Sunray, Texas, which has been operating for eight months—indicates flexibility of operation over a wide variety of conditions.

Feature of the unit has been its ability to handle feed stocks much heavier than normally can be processed in conventional delayed coking. The Shamrock unit is illustrated in the flow diagram.

Panhandle vacuum residua, which represents approximately 10% on the crude, was processed under various reaction temperatures to produce a gasoline with an octane number 10 to 15 points higher than is possible with delayed coking. The gas contained approximately 50% olefins as compared with 15% from delayed coking. The process, being continuous, eliminates the intermittent cleaning of coke drums and attendant expense.

The process as installed at Shamrock is the first commercial installation of the "mass-flow lift" developed by Union Oil Co. of California. The unit consists essentially of 1) a reactor in which the oil-wetted coke particles or "seed" coke flow downward as a dense bed (sufficient time is provided in the reactor for cracking, coking, and drying reactions); 2) a reheater in which circulating coke is raised in temperature to supply the heat of reaction, some sensible heat to the feed, and radiation losses; 3) a coke-circulating system using a principle which elevates the coke as a dense, unagitated column; and 4) a fractionation system.

A continuous contact coking unit, in combination with vacuum flashing to a heavy pitch, will produce a maximum of middle distillate, and thus provide a new tool to help meet the industry's need for higher yields of middle and light distillates.

Feed stock characteristics at Shamrock are listed in Table 1. Yields for a range of reactor temperatures are presented in Table 2.

In tests for yield vs. temperature for 50 runs under varying operating conditions, results were found to be similar to those obtained from a delayed coking operation. However, contact coking shows considerably lower coke production with higher gas and gasoline yields.

Experience has shown that lower operating temperatures are practical, and could be attained by still further preheating of the feed stock to the extent that the heat of vaporization is supplied in a tubular heater. Thus coke temperature levels are reduced throughout. A reduction of this type will reduce the gas and gasoline production with a corresponding increase in the gas oil yield.

Economic comparison figures and costs are indicated in the data in Table 3 for a 2500-b/d unit charging the Panhandle vacuum bottoms. The contact coker is favored by a figure of some $514,000 per year.

Table 2—Summary of Yields with Various Reactor Temperatures

Test No.	1	2	3	4
Average reactor temp., °F.	1025	985	965	955
Yields, wt.-%:				
C_3 and lighter	18.6	17.1	15.8	14.5
C_4 to 400-F gasoline	29.9	27.2	24.0	22.0
Gas oil	37.5	42.2	47.2	51.0
Coke	14.0	13.5	13.0	12.5
Res. oct., without TEL, ASTM:				
D 908 method, corrected to 10 lb. R.V.P.	84.0	80.5	76.6	75.0

Table 3—Comparison of Contact with Delayed Coking

(Processing 2500 b/d of vacuum bottoms)

	Contact		Delayed	
	Wt.-%	Vol.-%	Wt.-%	Vol.-%
Yields:				
Gas, C_3 and lighter	14.9		7.5	
Gasoline, C_4 to 400-F.	21.1	26.6	18.5	23.4
Gas oil	51.0	55.0	54.0	58.0
Coke	13.0		20.0	
Olefins in gas	50.1		15.1	
Utilities:				
Water, gpm.	1600		2200	
Steam, lb./hr.	13,000		10,000	
Fuel, million Btu./hr.	29		25	
Electricity, kw	50		50	
Operating labor, men/shift	2		4	
Investment, dollars	1,600,000		2,100,000	
Direct charges, $/day:				
Raw materials	2500		2500	
Utilities	417		363	
Labor	108		216	
Maintenance	110		130	
Total charges	3,135		3,209	
Value of products, $/day	8,151		7,765	
Differential profit,* $/day	5,016		4,556	
Differential profit,* $/yr.	1,655,280		1,503,480	
Payoff,* months	11.6		13.9	
Assumed Values of Charge Stock, Products, Utilities, Labor (both processes)				
Charging stock, $/bbl.	1.00			
Products:				
Gas, ¢/million Btu.	29			
Gasoline, ¢/gal.:				
80-octane number	11.75			
64-octane number	11.00			
Gas oil, $/bbl.	3.00			
Coke, $/ton	6.00			
Utilities:				
Water, ¢/1000 gal.	1.5			
Steam, ¢/1000 lb.	55			
Fuel, ¢/million Btu.	29			
Electricity, ¢/kwh.	0.75			
Labor, $/hr.	2.25			

* Does not include taxes, insurance, amortization, interest, and royalties.

The preceding article is a condensation of the paper "The Lummus Continuous Contact Coking Process," presented at the 33rd annual meeting of the American Petroleum Institute, Nov. 9, in Chicago, by V. Mekler, A. H. Schutte, and T. T. Whipple, The Lummus Co., New York City.

"Foam" Floating Roof Pays Off

Field tests show consistent vapor loss reduction of 80-90%, Sohio team reports to the API

TESTS under a wide variety of operating conditions and in several tank sizes have shown that evaporation loss reduction in crude oil storage of 80 to 90% is attainable by use of the recently-developed "Microballoon" technique of Standard Oil Co. (Ohio). An earlier report on this vapor-saving method utilizing a blanket of tiny plastic spheres riding on the surface of the oil, much like a fluid floating roof, appeared in PETROLEUM PROCESSING in July, p. 1017.

Payoff on installations of the "Microballoons" is estimated at 6½ months, 10½ months, and about one year, based on general performance data Sohio has collected from two sources:

1—Operation of a pilot-scale battery of four specially fabricated, 40-bbl., cone-roof tanks, and,

2—Full-scale tests at a tank farm in central Ohio employing 88-ft. diameter storage tanks.

A preliminary field trial was also made in 1000-bbl. tanks near Mt. Vernon, Ill.

Quickest return is figured on working tank installations, according to Sohio's studies—about 6½ months on a 55,000-bbl. tank.

By using nomographs presented at a symposium on evaporation losses at the 1952 annual meeting of the American Petroleum Institute, total annual loss of 1880 bbl, is predicted for a 55,000-bbl. cone-roof tank under the following conditions.

Average R.V.P., psi.	5.0
Tank dimensions, ft.	100 x 40
Average liquid temperature, °F.	60
Average outage, ft.	20
Number of fillings per year	25
Total annual throughput, bbl.	1,300,000

The predicted breathing loss would be 1100 bbl./yr. and the filling loss 780 bbl./yr. While test results have not differentiated the effect of a foam covering between breathing and filling losses, the over-all loss reduction in working tank tests was similar to that in static tank tests and was in the neighborhood of 83%.

Thus, a similar tank under the above conditions with a "Microballoon" seal should have a total annual loss of about 320 bbl. With crude oil at a value of $3/bbl., the resulting savings would be $4700/yr., as compared to the cost of installing "Microballoons" of $2600.

Payoff in about one year was calculated for smaller tanks. On a 10,000-bbl. tank it might be desirable to install an automatic shut-off valve to safeguard against the loss of the foam covering when the tank is pumped out. This would increase the installation cost of $900 by another $200. In such a tank, of bolted construction, with a diameter of 55 ft. and a height of 24 ft. annual breathing loss would be 240 bbl. and filling loss 200 bbl., under the following conditions.

Average R.V.P., psi.	4.5
Average outage, ft.	13
Average oil temperature, °F.	55
Annual number of fillings	55
Annual throughput, bbl.	550,000

The estimated annual loss reduction with "Microballoons" would be 83%, resulting in an annual saving of approximately 365 bbl., or $1095 worth of $3/bbl. crude against an installation cost of $1100.

Even on old, wood-roof tanks, a payoff—10½ months—was figured. The original problem which had led to the "Microballoon" development was the very high stock losses experienced in tankage of this type being used for dead storage.

A special study of losses in 20 of these 25,000-bbl. tanks was made over a period of nine months and indicated an average loss of 1000 bbl./tank/yr. The investigation was made from the end of July through April of the following year. Since three summer months were not included, the average annual loss would be higher. The tanks are 88 ft. in diameter, 25 ft. high, and the oil height averages 16 ft.

Predicted savings with a foam covering would be 830 bbl. annually if the 83% reduction is applied to a

Table 1—Comparison of Crude Oil Properties

Properties	Initial	After 56 Days	
		Control	Foam
API Gravity	37.7	36.6	37.6
10% point, °F.	248	262	251
R.V.P., psi.	3.3	...	...

Table 2—Results of 40-bbl. Tank Static Test

(66-day Period)

		Control	Foam
Evaporation rate (gal./1000 sq.ft./day)		8.5	1.3
Equivalent annual loss (100-ft. tank), bbl.		580	88.6
Crude Oil Properties:	Initial	Final	
R.V.P., psi.	5.2	3.8	5.1
API Gravity	35.4	34.4	35.3
I.B.P., °F.	112	130	111
5%, °F.	189	201	190
10%, °F.	232	239	233
20%, °F.	304	315	305

Table 3—Results of 40-bbl. Tanks Worked Test

(66-day Period)

		Control	Foam
Evaporation rate (gal./1000 sq.ft./day)		7.7	0.2
Equivalent annual loss, (100-ft. tank), bbl.		525	13.7
Crude Oil Properties:	Initial	Final	
R.V.P., psi.	5.2	3.3	5.0
API gravity	35.4	34.2	35.3
I.B.P., °F.	112	137	123
5%, °F.	189	214	197
10%, °F.	232	250	238
20%, °F.	304	325	314

1000-bbl./yr. loss. Money savings then amount to about $2500 with $3/bbl. crude oil. Cost of a "Microballoon" covering, ½-in. thick, on this size tank would be $2200.

Installation costs on the various tanks were figured on the basis of a ½-in. thick seal or blanket, with the "Microballoons" at 85¢/lb., installed. This is shown graphically in the chart in Fig. 1. Physical properties of this material in current use on large-scale installations of Sohio, are as follows:

Bulk density, lb./cu.ft.	8.7
Particle density, lb./cu.ft.	20.7
Average particle size, in.	0.0013
Size range, in.	0.0002-0.0036

The initial small-scale test was carried out in two 1000-bbl. tanks about 22 ft. in diameter. Both tanks were approximately half full of the same crude oil but one of them was used as a control, and the other was covered with a ¾-in. layer of "Microballoon" foam. Gaging measurements were made over a period of two months with the results shown in Fig. 2. This graph also illustrates the method used throughout the test work to determine evaporation loss by gaging.

Careful gaging measurements on sets of isolated tanks are plotted against time for a period of weeks, and the rate of loss is determined from the slope of the loss-versus-time plot. The lines are established by the mathematical method of least squares deviation.

Even though evaporation losses over short periods are well within the individual gaging errors, they are cumulative while gaging errors are self-compensating over a time period for sets of isolated tanks such as used in these studies.

The literature contains many evaporation loss studies where other measuring techniques have been employed. These include measurements of vapor pressure change, vapor metering and analyses, and gravity and composition changes on the material being stored. For this study it was thought that significant gaging results would be the most useful if they could be obtained with a reasonable amount of effort.

To facilitate direct comparison of evaporation rates between tanks of widely different sizes, evaporation rates are expressed frequently in the units of gal./1000 sq. ft. of surface area/day.

Loss in the control tank was at the rate of 10.4 gal./1000 sq. ft./day versus 1.5 for the foam-covered tank

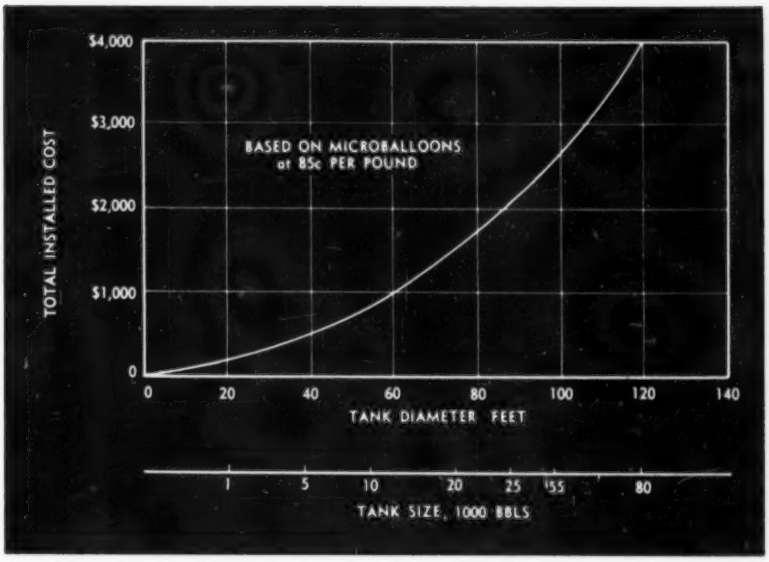


FIG. 1—Cost of a ½-in. Microballoon seal on various size tanks

in the same units. Thus, the control tank lost hydrocarbon 7 times faster than the foam-covered tank. The evaporation rate was reduced 85% by the use of the foam covering. Crude oil property comparisons before and after the test also indicated that the crude in the foam-covered tank changed substantially less than that in the control, as shown in Table 1.

Both gravity and 10% distillation point changed very slightly for the foam-protected crude while a larger change is observed in the control material.

Additional test work is available from a tank battery consisting of four small cone-roof storage tanks. Each of these was 8 ft. in diameter, 5 ft. high, with a capacity of about 40 bbls. All were equipped with conventional pressure vents weighted to hold 0.5 ounces of pressure and vacuum. Both roof and shell were painted white. The initial test in this group of tanks was similar to the 1000-bbls. tank tests in that tanks half full of crude oil, one covered with a one-inch layer of "Microballoon" foam, and one a normal control tank, stood for a period of approximately two months with periodic gaging. Evaporation loss rates and crude oil property changes are listed in Table 2.

Again it is seen that the foam covering produced a large decrease in the evaporation rate, and that crude oil properties changed much less in the foam-covered tank than in the control tank.

Small-scale worked tests: A pair of 40-bbl. tanks was used in the tests to determine the effectiveness of the covering under working conditions. In this case the small tanks contained two ft. of crude oil floating on a water bottom which was pumped back and forth to change the liquid levels at a rate equal to three ft./hr. Twice weekly, water was pumped from one of the tanks in the pair to the other, reversing the position of the levels on approximately a weekly cycle. The evaporation rates determined by gaging and crude oil property change comparison are shown in Table 3.

Again both the evaporation rate data and the property change data indicate a substantial reduction of evaporation loss by the foam covering under conditions where the tanks were worked on a one-week cycle.

Foam thickness is an important variable since the cost of the covering is directly proportional to the thickness. Small-scale laboratory work had narrowed the interest to the ¼ to 1-in. region. The relative value of a ½-in. covering vs. a 1-in. covering under weekly turnover conditions was established in a test employing the four 40-bbl. pilot-scale tanks. They were all half-filled with crude oil and a one-inch foam layer was installed on two while a half-inch layer was installed on the other two. Each pair was then pumped twice weekly at a 2-ft./hr. level-change rate through almost the entire tank volume, giving a one-week turnaround period. Evaporation loss rate measurements and crude oil property change comparisons are shown in Table 4.

This indicated the ½-in. covering to be 98% as effective as the 1-in. covering under these working conditions. Similar data are being collected on a ¼-in. covering.

Large-scale field test work: Information is available on similar type tests

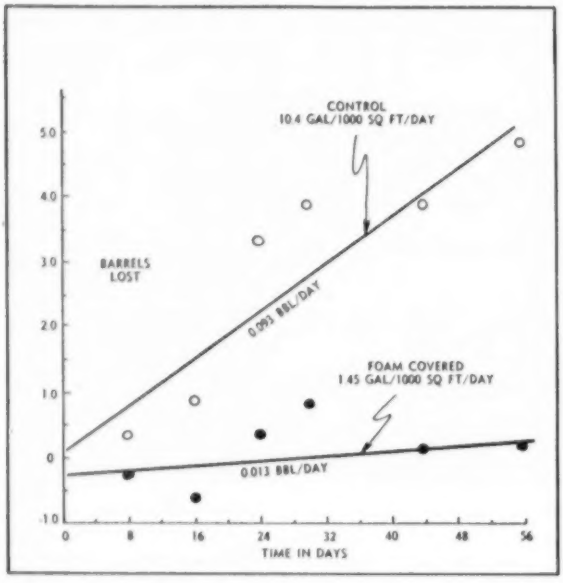


FIG. 2—Gaging results, 88-ft. worked tanks

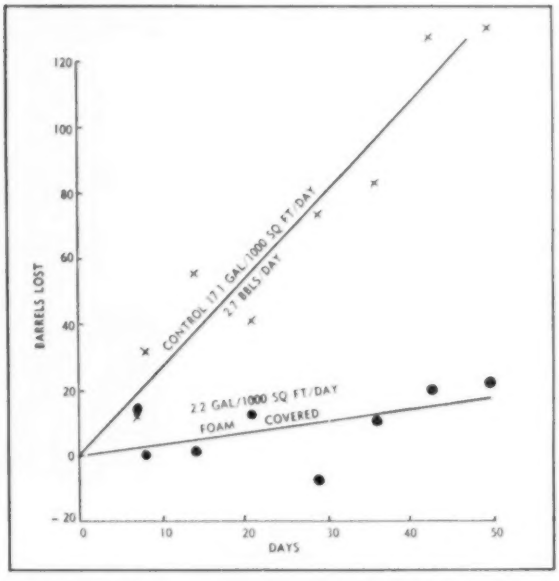


FIG. 3—Field test evaporation results, 1000-bbl. tanks

conducted in 25,000-bbl., 88-ft. diameter storage tanks using a 1-in. covering of "Microballoon" foam. The first of these is a 10-month static storage test using tanks in good condition, fitted with conservation vents. Evaporation loss rates and crude oil property changes during the period are given in Table 5.

A two-month working test in the same size storage tank with open vents is also available. In this test the working cycle was approximately two weeks and again the 1-in. thickness foam covering was employed. Evaporation-loss rate results are given in Fig. 3. This shows an 86% reduction of evaporation loss produced by the foam covering. Crude oil property change data for this test are given in Table 6.

Table 4—Foam Thickness Tests Results

(40-bbl. tanks; 1-week turnover; 67-day test period)

	1-in. covering		½-in. covering		No foam
Evaporation rates, (gal./1000 sq.ft./day)	2.20		2.48		15.7 (est.)
Equivalent annual loss, (100-ft. tank), bbl.	150		170		1070
	Initial	**Final**	**Initial**	**Final**	
API gravity	36.4	35.7	36.1	35.5	
R.V.P., psi.	6.1	5.3	5.6	4.7	
IBP., °F.	102	111	102	110	
5%, °F.	157	173	170	189	
10%, °F.	204	224	220	228	
20%, °F.	290	311	284	290	
30%, °F.	399	410	397	406	

Table 5—Results on 25,000-bbl. Tank Static Test

(10-month period, 1-in. foam covering)

Average evaporation loss rate (gal./1000 sq.ft./day)	1.57	
Bbl./yr.	86.5	
Normal estimated loss, bbl./yr.	690*	
Crude oil property changes:	**Initial**	**Final**
API gravity	36.0	35.7
R.V.P., psi.	5.3	4.9
I.B.P., °F.	123	117
5%, °F.	185	192
10%, °F.	235	235
20%, °F.	312	311
30%, °F.	402	409

* No comparable control data available; these are from the 1952 API symposium on evaporation losses.

These data again show substantially less change in the crude oil protected with the foam covering than in the control test.

Performance summary: The general picture with respect to the evaporation-loss reduction under a variety of conditions of tank size, operation, and crude oil vapor pressure is shown in Table 7. All data listed are for a ¾- to 1-in. foam thickness. This gives an over-all average loss reduction of 83%.

It is interesting also to compare the measured loss rates in the control tests with what might be predicted from the literature. The most authoritative recent literature on the subject is that of the Chicago, 1952, A.P.I. "Symposium on Evaporation Loss." The details of the test data and the symposium nomographs were used to make the calculations in Table 8 for the two field tank tests.

The agreement, while far from quantitative, is reasonably good considering the uncertainties involved and serves to bolster the general accuracy of the evaporation-loss rates determined by the gaging procedure.

Installation of "Microballoons": The most practical method of installing "Microballoons" on tanks which are in service has been found to be pumping them in, mixed with crude oil. This is accomplished by the use of a hopper mounted on top of an aspirator. The aspirator which has been used is one which is commonly employed in chemical foam fire fighting systems.

The pumping equipment consisted of a 150-bbl./hr. rotary pump driven

by a gasoline engine. With this equipment it is possible to install "Microballoons" on a 90-ft. diameter tank in approximately three hrs. The aspirator and hopper can be connected so the oil and "Microballoons" are pumped into the regular inlet or through a hose into the top of the tank.

The oil required for the aspirator can be obtained from another tank or from the tank on which the foam covering is to be installed. A pressure of approximately 100 psi. was required on the aspirator inlet to give the required velocity on the outlet of the nozzle.

It was possible to add up to 20 lbs. of "Microballoons" per minute to the oil, resulting in a fluid slurry of "Microballoons" in crude oil. Only 400 to 500 bbls. of oil are necessary to pump 3,000 lbs. of "Microballoons" into a tank. This would be enough particles to form a ½-in. layer on a 90-ft.-diameter tank.

A number of other methods for installing the material have been tried. One of these involved the use of a farm elevator of the type commonly used for filling silos. The only change required in the elevator was to enclose the top to prevent the "Microballoons" from being blown away. Although this device worked quite well, it is believed to be somewhat dangerous.

There is metal-to-metal contact between the elevator trough and the buckets or plates carrying material up to the trough, and since the upper part of the elevator is mounted directly over a roof opening, there is danger of a spark igniting the vapor in the tank. Such an elevator could probably be made safe by eliminating the metal-to-metal contact near the tank opening.

Another method which was considered but not tried because of the success of other systems was a blower of the type used to install insulation in homes. With such a device, the foam covering could be installed in a very short time. Insulation blowers are usually available for rental in most areas. However, the use of an insulation blower might involve the danger of a spark from static electricity. "Microballoons" are hollow spheres of plastic and the friction caused by blowing the particles into the tank with air might build up enough static charge to cause a spark inside the tank. On new or gas-free tanks, the use of an insulation blower might be the most economical method.

There are other methods which could be used, one of which is merely carrying the "Microballoons" in their paper shipping bags to the tops of the tanks and emptying them into a tank opening. However, the hopper-and-aspirator method appears to be so practical that there is little reason to try other methods.

An advantage of pumping the "Microballoons" into the tank with crude oil is that the foam spreads evenly over the surface of the oil and is saturated with the crude oil immediately. When dry "Microballoons" are dumped on the surface of the crude oil, the foam tends to be quite thick below the point of entry and relatively thin on other parts of the tank. With sufficient time the foam would spread out to a uniform layer but it is probably advisable to use a spray or some other method of stirring the surface to form a more nearly even layer. Evaporation is appreciably reduced almost immediately after installation of the foams when the aspirator-and-hopper method is used, as indicated by vapor analyses.

Gaging "Microballoon" - covered tanks is practically the same as present practice, except for adding a gage well on the gage line. A practical gage well we have used consists of a 1-in. copper tube, eight in. long on which is mounted a copper float. When the gage line is lowered into the tank, the plumb bob will penetrate the foam and the whole apparatus continues on down into the crude oil until the gage well floats. "Microballoons" are eliminated from the surface of the oil inside the float well allowing a sharp reading on the gage line.

The taking of tank temperatures and the thiefing of a tank are no different from present practice. Even if small quantities of "Microballoons" float on the surface of the thermometer well they do not cause any errors in the temperature reading. Those which float on top of the thief can be poured off with the top few inches of oil. If "Microballoons" get into a sample from which a B.S.&W. reading is made, they rise to the top in the centrifuge tube and do not cause errors.

Practical service life of "Microballoons" will be decided only in the field. At present, examination of the covering on large tanks in service for over one year have shown no change in thickness or appearance. As shown in Table 9, measurements on foams in drum-scale storage for two years indicate no significant changes.

The very slight density differences indicate that the particles are not filling with liquid by diffusion through the walls. These data would suggest a lifetime in crude oil service considerably longer than the required economic life. The life of the protective foams on

Table 6—Results on 25,000-bbl. Tank Worked Test

(50-day Test Period)

	Control		Foam-covered	
	Initial	Final	Initial	Final
API Gravity	33.5	31.9	35.3	34.9
R.V.P., psi.	3.0	1.25	4.7	4.5
I.B.P., °F.	129	158	128	120
5%, °F.	178	240	211	225
10%, °F	212	280	249	256
20%, °F.	336	366	330	349

Table 7—Evaporation Loss Rate Reduction Summary

Type of Test	Tank Conditions	Crude RVP	Loss Rates gal./1000 sq.ft./day Control	Foam	% Rate Reduction
Static	1000-bbl. Open vent	3.3	10.4	1.5	85
Static	40-bbl. Cons. vent	5.2	8.5	1.3	85
Static	Same	7.3	10.0	2.6	74
Worked	40-bbl. Cons. vent	5.2	7.7	0.2	97
Worked	Same	8.5	15.2	4.6*	70*
Worked	25,000-bbl. Open vent	3.0	17.1	2.2	86
Average % Rate loss reduction					83

* Estimated by vapor analysis.

Table 8—Comparison of Evaporation Rates for Control Tanks

(Annual Loss Rate in bbl.)

	Measured	Calculated
1000-bbl. static, open vent, 3.3 RVP crude	35	49
25,000-bbl. worked, open vent, 3.0 RVP crude	985	1480

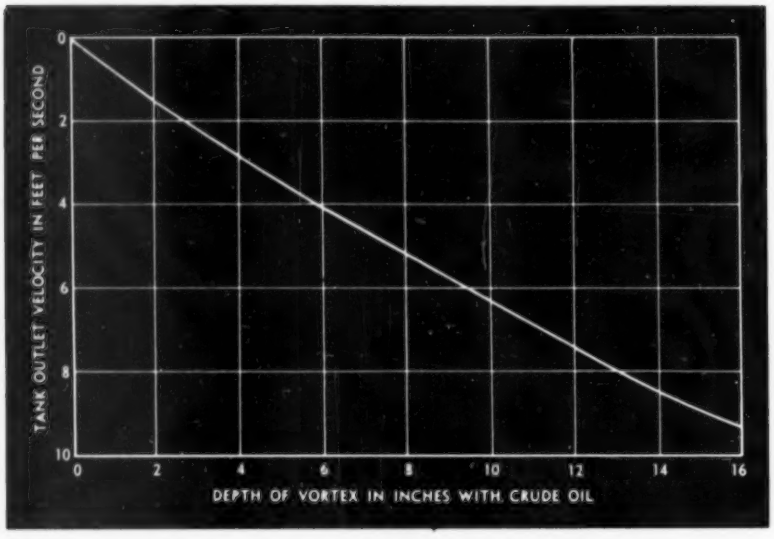


FIG. 4—Depth of vortices in crude oil tanks

actual tankage will probably depend more on frequency of tank cleaning which might result in the loss of part or all of the "Microballoons," and on operation mishaps such as pumping the foam out of the tanks. When a tank with a "Microballoon" covering is cleaned it may be possible to save substantial amounts of the foam material for reuse.

Protection Again Loss: The cost of the covering on various size tanks was shown in Fig. 1. Since the foam covering is relatively valuable its loss should be avoided. Most companies try to guard against overflow with a resulting loss of oil and cleanup expense. With "Microballoon"-covered tanks, it will be necessary to guard not only against overflow, but also against pumping a tank too low.

In the operation of most large oil tanks it is the usual practice to avoid drawing air which might harm pumping equipment and result in errors of measurement of crude oil stocks and line fills. With sufficient stress by the operators on the low-level shut-off point, the loss of "Microballoons" should be kept to a relatively minor occurrence. The shut-off height should be established so that vortices will not cause the loss of "Microballoons." Fig. 4 is a chart of vortex heights which have been obtained by measurements on crude oil tanks which do not have a foam covering.

It is anticipated that the foam on top of the crude oil in the tank will substantially reduce the vortex height because it tends to prevent the surface of the oil from moving in a circular motion. In tanks equipped with swing lines the shut-off height must be set above the swing-line height.

Automatic shut-off valves are an answer to the loss of "Microballoons" on small tanks which are not equipped with swing lines. Since these valves are presently made only in the smaller sizes they will only be useful on tanks where the withdrawal rate is relatively low. They will also aid in preventing loss of "Microballoons" on isolated gathering tanks which are commonly pumped out until shut down by loss of flow.

In the event that "Microballoons" do get pulled out of the tank, they will not damage pumping equipment, meters or other mechanical apparatus. They are plastic material and much less abrasive than the sand or scale which is found in small amounts in most crude oil. If they are drawn into a pipeline that is operating at more than a few hundred psi, they will be crushed and will end up in B.S.&W. They should not have any harmful effect on refinery units since they are made from a thermosetting resin and will not soften or liquefy at high temperatures. Any "Microballoons" which get into a refinery crude supply should end up in asphalt or coke.

Table 9—Comparison of Microballoon Properties

(2-yr. Crude Oil Storage)

	1951	1953
Density, gm./cc.		
Liquid displacement	0.21	0.22
Gas displacement	0.29	0.26
Average particle size, microns	18.9	19.6
Size range, microns	0.5-60	0.5-60

Effect on fire hazard: On normal cone-roof tanks vapor measurements have indicated that an explosive vapor exists whenever a crude oil tank is being pumped out and for many hours thereafter. During the remainder of the time, when the tank is full or being filled, the vapor is usually too rich to explode. It is estimated that the vapor in normal crude oil working tanks is probably in the explosive range from 25 to 50% of the time.

Sufficient results are not available on tanks covered with "Microballoons" to indicate what per cent of the time the vapor of such tanks is in the explosive range.

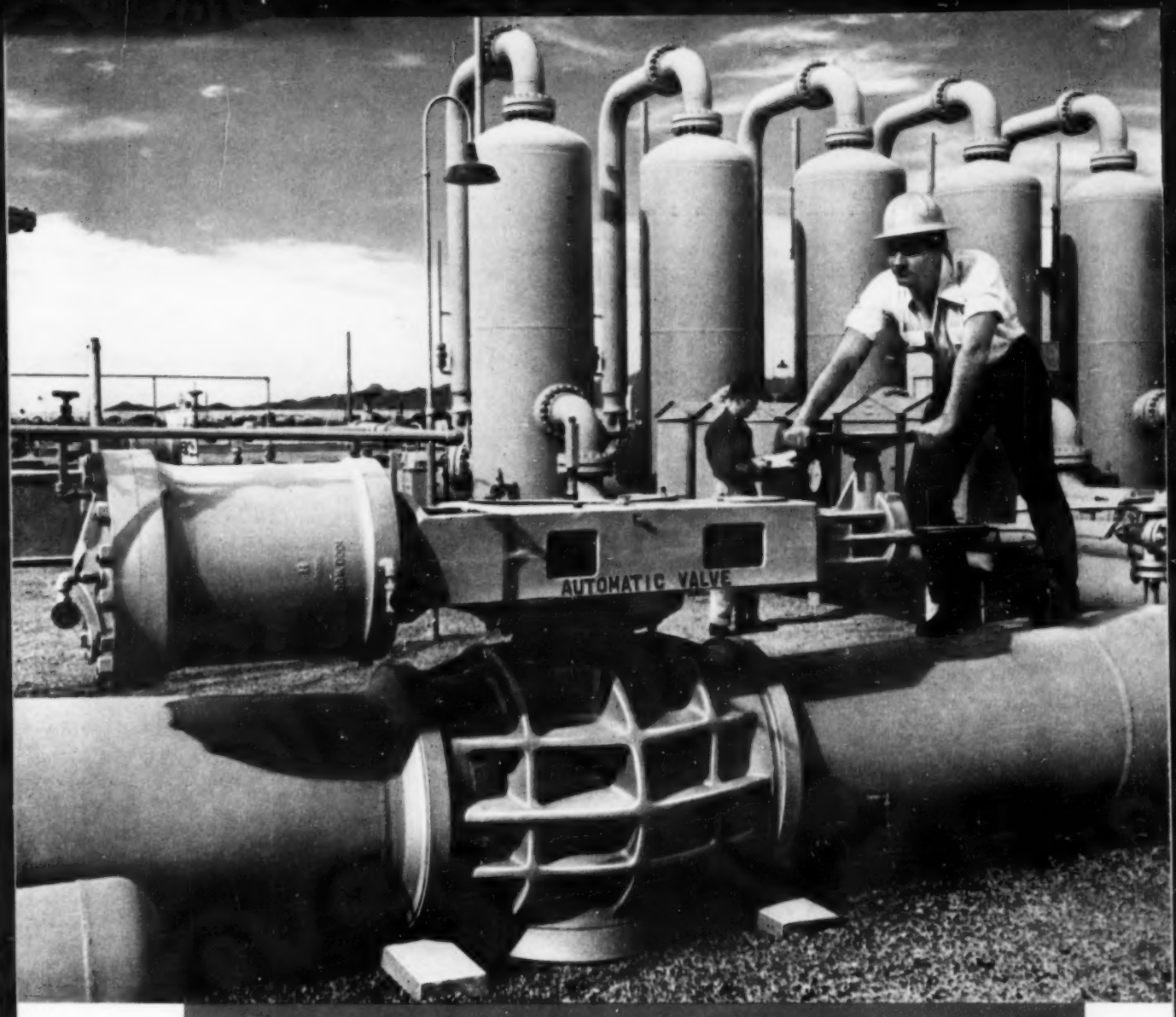
However, measurements have shown that with the "Microballoon" covering on tanks with open vents, the vapor will be too lean to support a flame a large percentage of the time. The majority of foam coverings which have been installed on tanks to date have been on tanks which were in static storage use and did not have vapor-tight roofs.

The vapor in these tanks was always in the explosive range prior to the installation of "Microballoons." Following the installation, the vapor remained below the flammability limit. Since the normal vapor-tight tank is in the too-rich range most of the time, it may be wise to remove the vents, or keep them open after installing "Microballoons."

Acknowledgment

The authors of this A.P.I. paper, E. G. Ellerbrake of Sohio Pipe Line Co. and F. Veatch, of Standard Oil Co. (Ohio), expressed their gratitude for the encouragement and assistance of the many administrators, operators, and technical men who were associated with this development. Special mention was made of R. D. Croft, A. D. Dorris, and R. W. Burhans. Thanks were also given to Chicago Bridge & Iron Co. for providing the 40-bbl. tanks used in the pilot-scale studies, and the Bakelite Corp. for their cooperation in the large-scale manufacture of "Microballoons."

Note: This article is based upon the paper "Microballoons and Their Use in Reducing Evaporation Losses of Crude Oil," presented at a meeting of the Evaporation-Loss Committee during the 33rd annual meeting of the American Petroleum Institute, Chicago, Ill., November 9, 1953, by E. G. Ellerbrake, Sohio Pipe Line Co., St. Louis, Mo., and Frank Veatch, chemical and physical research division, Standard Oil Co. (Ohio), Cleveland.



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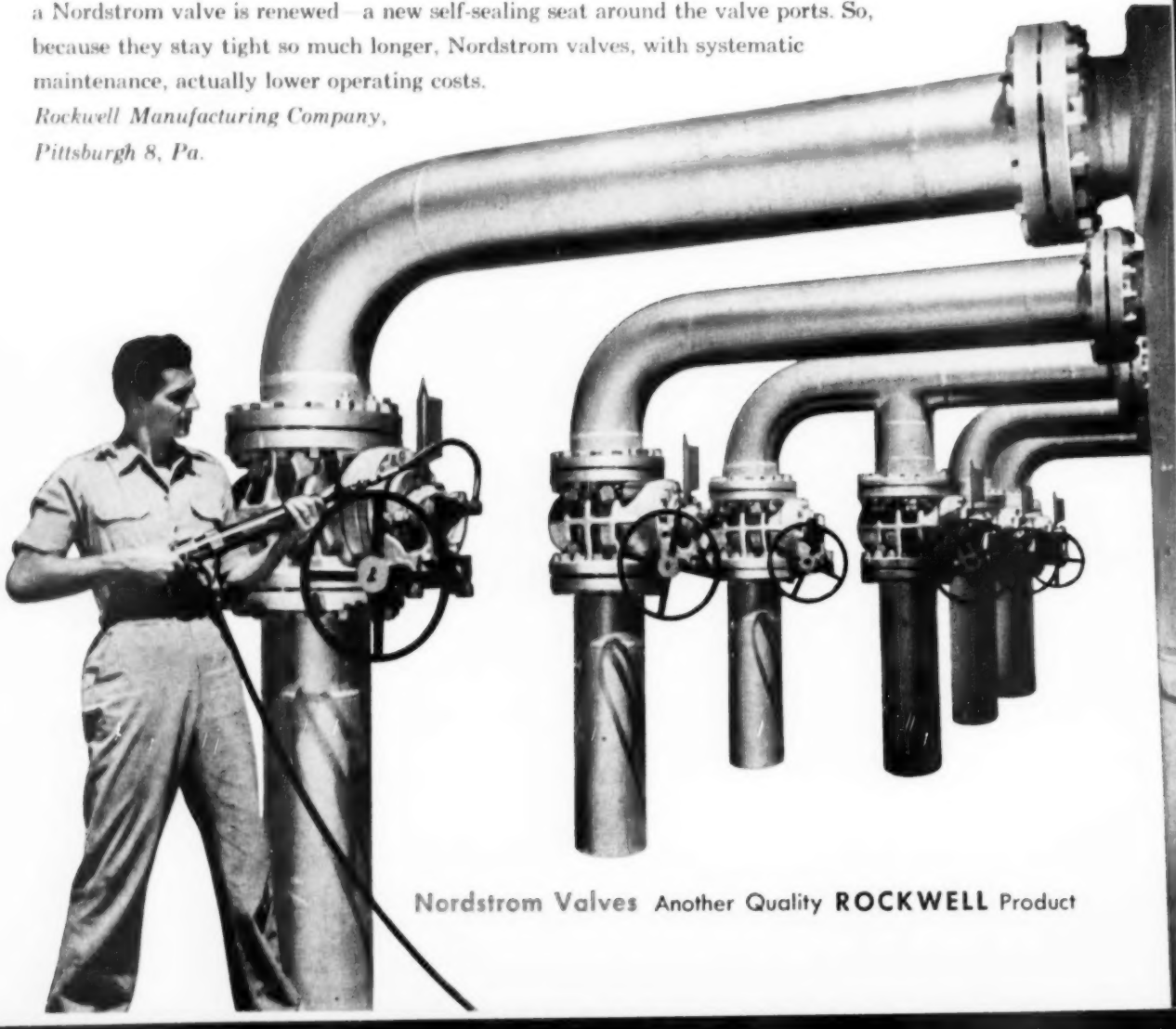

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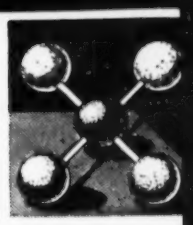

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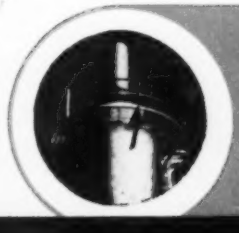

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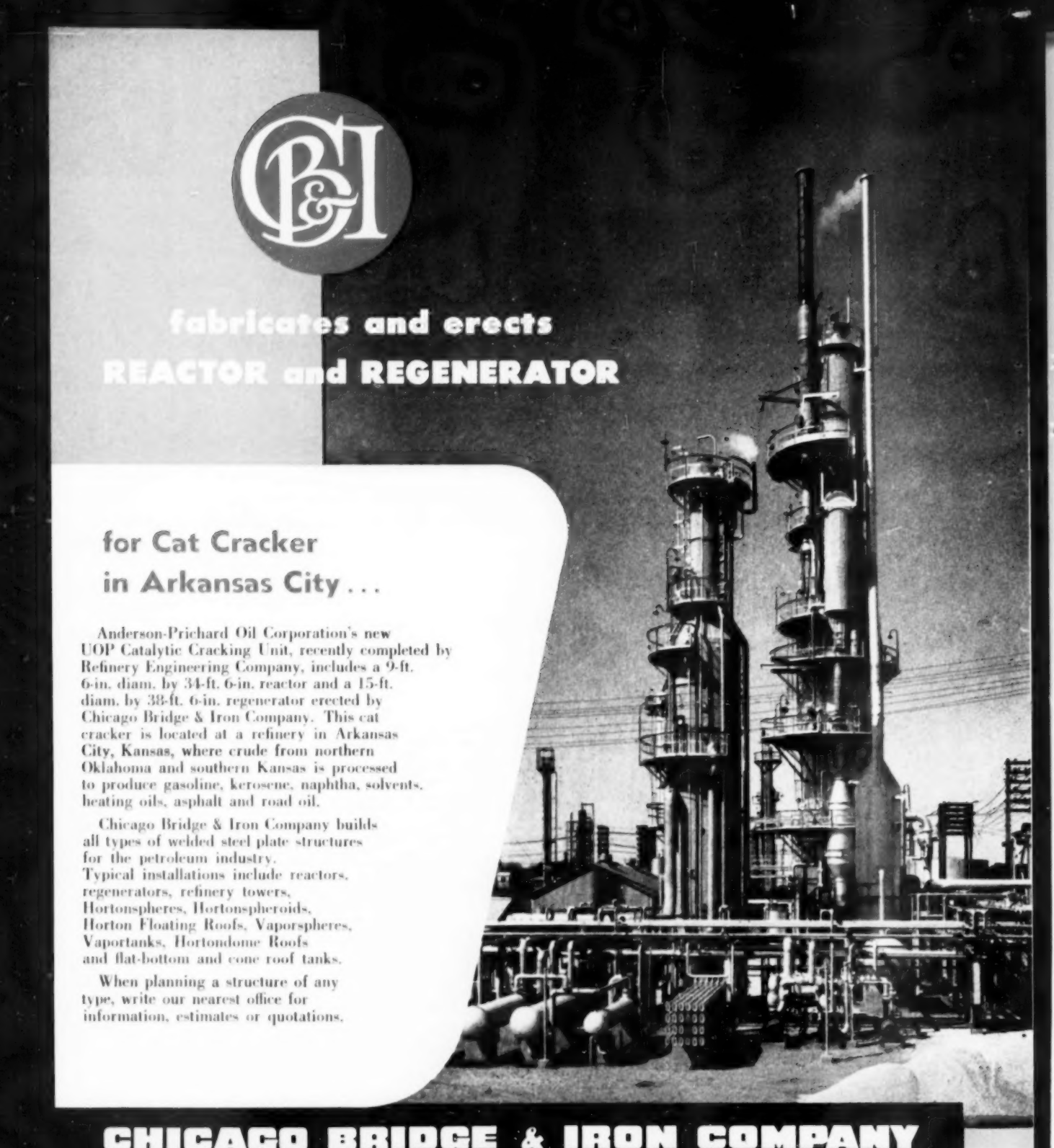

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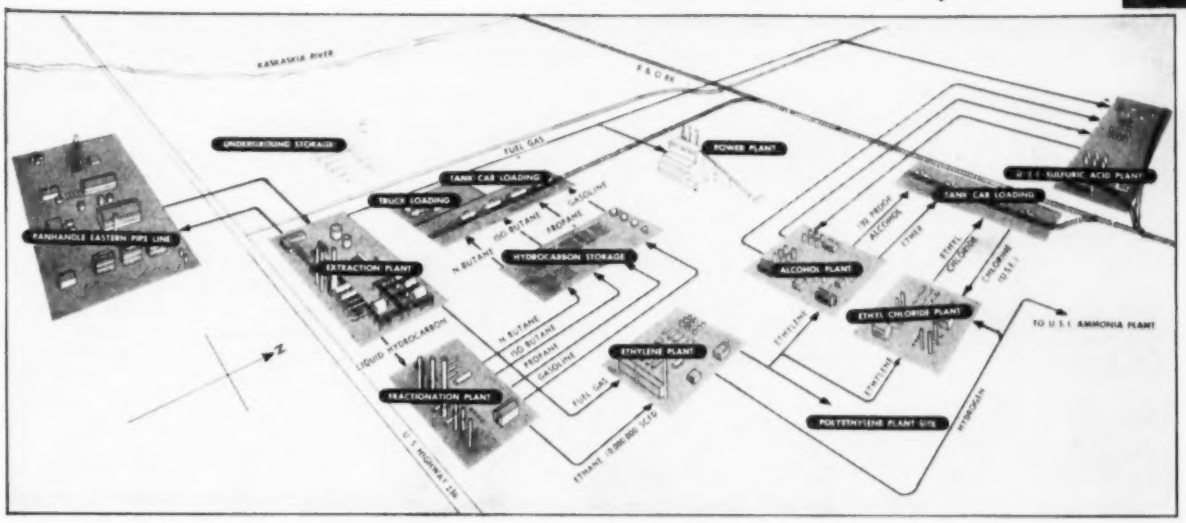


WELL-PLANNED LAYOUT of NPC's new plant shows up in this flow diagram

What's Unique About Tuscola?

The new $50,000,000 plant of National Petro-Chemicals Corp.

NEWEST petrochemical plant in the U.S.—the $50,000,000 venture of National Petro-Chemical Corp. at Tuscola, Ill.—was officially dedicated last month on Armistice Day, Nov. 11.

The Tuscola plant extracts ethane from natural gas, cracks it to ethylene, and then uses the ethylene as a building block for making ethyl alcohol and ethyl chloride. A small amount of by-product diethyl ether is recovered in conjunction with the alcohol operation.

In many ways, the plant is like any other of the many new petrochemical plants built in recent years. It's completely new, it's well-planned and laid out, it uses conventional processes.

But there are a number of other facets to the National Petro-Chemicals plant at Tuscola — unique facets which set it apart from most other petrochemical operations:

1—It literally sits on top of a trans-continental pipe line, and pulls its raw material—ethane—out of the gas as it passes by.

2—It boasts the largest unit ever built for cracking ethane to ethylene—with a capacity of 200,000,000 lbs. a year.

3—It is in a very favorable location with respect to markets, as contrasted to most petrochemical plants in the southwest; in fact, some of its products will be sold entirely within a radius of 100 miles of the plant.

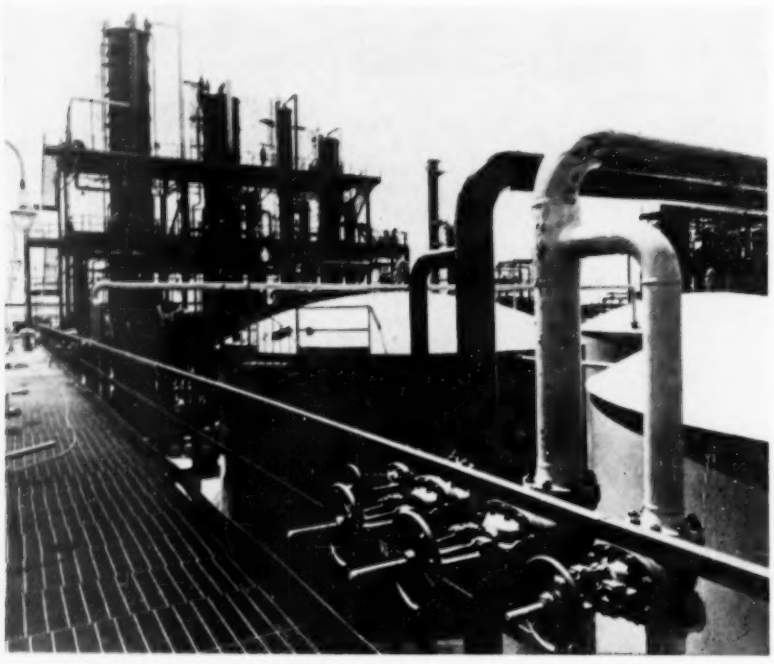
4—Its entire theme of operation is quantity production and bulk sales to a few consumers—whose needs are large but not large enough to justify a plant of their own.

Tuscola's products, in addition to the petrochemicals listed earlier, also include sizable quantities of LPG and natural gasoline, recovered in the process of extracting its ethane from the natural gas stream. The quantities of both the hydrocarbons recovered and of the intermediate and primary petrochemicals produced are listed below:

Hydrocarbons Recovered:	
Ethane, scf/day	10,000,000
Propane, gal./day	380,000
i-Butane, gal./day	21,300
n-Butane, gal./day	57,400
Gasoline (C^5+), gal./day	18,520
Intermediates from Ethane:	
Ethylene, lbs./day	600,000
Hydrogen, scf/day	8,000,000
Primary Products:	
Ethyl Alcohol, gal./yr.	40,000,000
Diethyl Ether, gal./yr.	3,000,000
Ethyl Chloride, lbs./yr.	50,000,000

The hydrocarbon extraction and recovery units have been in operation since July; the ethylene and alcohol units were being put on stream at the time of the dedication; the ethyl chloride unit was being completed at that same time and was expected to be in production in December.

In the future for Tuscola are two additional units—polyethylene and ammonia. The foundations for the first polyethylene unit are being excavated this fall, and the unit is expected to be in operation by the second quarter of 1955; initial production will be about 25,000,000 lbs./yr., with



ETHYL ALCOHOL UNIT at Tuscola plant will produce 125,000 gal. of 192 proof alcohol a day—20% of all synthetic alcohol produced in the U.S.

further expansion scheduled for the ensuing two or three years.

The ammonia unit will use by-product hydrogen from the ethylene unit and is being built adjacent to the National Petro-Chemicals plant by National Distillers U.S.I. Chemicals Division—an affiliated company. It will cost $7,000,000 and will produce 50,000 tons of ammonia a year.

And that opens up a new facet of Tuscola. The National Petro-Chemicals plant requires sulfuric acid for its alcohol synthese. The acid is produced by the same U.S.I. Chemical Division in another new plant (now operating) adjacent to the NPC plant. That makes Tuscola the only place in Illinois and one of the very few in the country where both ammonia and sulfuric acid will be produced side by side.

As a consequence, it is almost a certainty that a number of fertilizer plants—urea, ammonium nitrate, ammonium sulfate—will be built in that area in the near future.

National Petro-Chemicals Corp. is a new company—formed in 1951 as a joint venture by National Distillers Products Corp. and Panhandle Eastern Pipe Line Co. It is owned 60% by National Distillers, which operates and manages the venture, and 40% by Panhandle Eastern.

National Distillers Products Corp., organized in 1924, is a leading manufacturer of alcoholic beverages, but has become an increasingly important manufacturer of chemicals in recent years. Its National Distillers Chemical Co. Division is a major manufacturer of metallic sodium and chlorine. In 1951, U.S. Industrial Chemicals, Inc., was merged into National Distillers and now operates as a division under the U.S.I. name. In the same year the corporation acquired a 20% interest in Intermountain Chemical Corp., which mines natural soda ash used in the making of glass. In 1952, National acquired the business of Algonquin Chemical Co., producers of chlorine, caustic soda and sulfuric acid.

Panhandle Eastern Pipeline Co., incorporated in 1929, is a pioneer in the long distance transmission of natural gas. Its principal pipe line extends approximately 1200 miles from the Panhandle and Hugoton gas fields in Northwest Texas and Oklahoma through Kansas, Missouri, Illinois, Indiana and Northwestern Ohio to Detroit.

At Tuscola, the main line of Panhandle Eastern is joined by another major pipe line coming from the Brownsville, Texas, and Louisiana—operated by the Trunkline Gas Co., a Panhandle Eastern subsidiary.

This junction, along with other considerations, resulted in the selection of Tuscola as the site of the new petrochemical plant.

Gas for Tuscola is delivered to the extraction unit from a main line compressor station of Panhandle Eastern, located just across the road from the petrochemical plant. The extraction unit is designed to process a normal maximum of 400 million cu. ft. of gas daily, and a peak of 425 million cu. ft. The gas is first dehydrated, and then processed for the recovery of about 40% of its ethane content and essentially all of its C_3 and heavier hydrocarbon content.

Design and operation of this hydrocarbon recovery section of the Tuscola plant is described briefly in this issue in the story beginning on pg. 1894, and has been covered in more detail in an earlier article (June 1953, pg. 897).

The ethylene unit received ethane from the recovery section for purification, cracking and ethylene recovery. The ethane is first scrubbed with caustic to remove minor quantities of sulfur compounds. Conversion of the purified ethane to ethylene is accomplished at elevated temperatures in a bank of eight furnaces.

The furnace or heater effluent, containing between 20 and 30% ethylene, is shock quenched by a water spray and further cooled by the cooling water system. The cooled quench spray carries with it a large proportion of the tars, heavy polymers, and coke. These materials are removed from the water in a surge drum prior to the reuse of the water.

Hydrocarbons from the quench drums are stripped of all compounds heavier than pentane in a light oil absorption tower. The rich oil is steam stripped for reuse. The scrubbed gases from the absorber are compressed stepwise with cooling between each pressure stage.

Final utilization of the ethylene from this plant prohibits acetylene in the end product. Therefore, practically all acetylene is converted to ethylene by catalytic hydrogenation.

Wet gas from the converters is further compressed with interstage cooling and subsequent water knockout, and dried with trays of activated aluminum oxide. Regeneration of the drier trays is carried out with heated gas from the cracking heaters.

Exit gas from the driers is cooled by propane refrigeration and charged into a refrigerated absorption tower for the removal of methane and hydrogen from the mixture of ethylene

and higher molecular weight hydrocarbons.

The absorber overhead of hydrogen and methane contains a small amount of higher molecular weight compounds including some lean oil. These compounds are removed in two ways. A portion is refrigerated to extremely low temperatures until all hydrocarbons have been condensed, leaving an essentially pure hydrogen which is sent to ethyl chloride plant for further processing. Starting in late 1954 the balance of the hydrogen will be purified and used for ammonia production. The light oil is returned to the absorber feed and other lighter hydrocarbons enter the plant fuel system. The main portion of the overhead gas is cooled by expanding through a turbo-generator where a portion of the energy of compression is regained. Most of the light oil is recovered as condensate after the expansion. The remaining gas is utilized as fuel in the cracking furnaces.

Ethane and ethylene are removed from the rich absorber oil in a deethanizer, leaving a lean oil which is contaminated with some higher olefins. This oil is rerun in a still column and the light oil returned to the lean oil reservoir.

The final tower in the ethylene plant fractionates the ethylene from the ethane present in the deethanizer overhead. Reflux is obtained by refrigeration and compression. The overhead product consists of an ethylene with a minimum purity of 95%.

Propane refrigeration is used throughout the entire unit and two temperature levels are maintained; one at —15° F. and the other at 40° F. The refrigeration system uses two 4400 hp centrifugal compressors.

Ethyl alcohol is produced from ethylene by the sulfuric acid process. Ethylene is absorbed in strong sulfuric acid to form ethyl sulfate; the sulfate is hydrolyzed with water to form alcohol, which is steam stripped from the acid. The acid is reconcentrated under vacuum and fortified for reuse in the process. The crude alcohol is refined by distillation to produce the final products of 190 proof ethyl alcohol and diethyl ether.

Approximately 7,700,000 cu ft/day of ethylene is supplied to the ethanol synthesis unit by the ethylene plant. This ethylene is contacted with strong sulfuric acid in two liquidfull, absorption towers; the absorption is carried on at elevated temperatures and pressures in order to complete the reaction in a reasonable reactor volume. The diluent gases in the feed along with a small stream of unabsorbed ethylene are vented from the absorbers and returned to the ethylene plant. The ethylene-sulfuric acid "absorbate" is discharged from the absorbers and sent out to intermediate storage.

The hydrolysis step is carried out in a corosion-resistant reactor, forming ethyl alcohol and diethyl ether. In a conventional-type distillation column, open steam is used to strip ethyl alcohol and ether from the weak sulfuric acid that was released by the hydrolysis of ethyl sulfate. Crude alcohol is neutralized with caustic and sent to storage. Spent acid from the stripper bottoms is pumped to storage before feeding to the acid concentrator.

The crude alcohol is refined in a series of distillation columns, first to remove ethyl ether, second to remove impurities boiling in the same range as alcohol, and third to refine the alcohol. The removal of impurities is by extractive distillation. A batch still is available for occasional recovery of ether of special grades, and also for recovery of alcohol and other components of the impurity stream.

Heat requirements of this purification system, with its large quantities of dilution water to be removed by distillation, was of prime importance in the design. To conserve heat, the columns employ a vapor-reuse system. Open steam is supplied to the bottom of the rectifier; the overhead vapors are used to supply heat to the reboilers of the ether and extractive distillation columns. Reboiler condensate is then returned to the rectifier reflux drum. In order to obtain a satisfactory temperature difference in the reboilers, the rectifier is operated under pressure.

The acid concentrators are conventional Simonson-Mantius vacuum units which raise the concentration of the weak acid to 92 wt.-% sulfuric acid. There are six concentrators, operating at 4.0 to 0.4 inches of mercury and using 65 psig, 150 psig, 300 psig steam in bayonet heaters to supply the necessary heat. The concentrated acid is pumped to the U. S. Industrial Chemical sulfuric acid plant where it is fortified to full strength and returned to the alcohol unit, A portion of the acid is also removed from the concentrators at 77% acid strength and delivered to U. S. Industrial Chemicals for external sale, mostly for production of superphosphate.

The variety of chemicals handled in the alcohol unit has resulted in a very wide range of construction materials. In cold concentrated acid and absorbate services, steel is used; for the same chemicals at elevated temperatures, Hastelloy, Carpenter 20, Durimet 20, etc. are used. The hydrolyzer and stripper are steel, lead lined and carbon brick lined with carbon trays and bubble caps to withstand hot, dilute sulfuric acid; Karbate pumps, with lead and carbon lined piping are used to transport these materials. Weak acid storage tanks are steel, lined with tygon sheet and acid brick. The acid concentrators are steel lined with sheetlead and then acid brick. Tantalum and Hastelloy are used in the heating tubes, and Hastelloy lead and carbon lined valves and piping for the acid streams. The finishing section is primarily copper and copper lined columns and lines with cast iron, bronze fitted pumps.

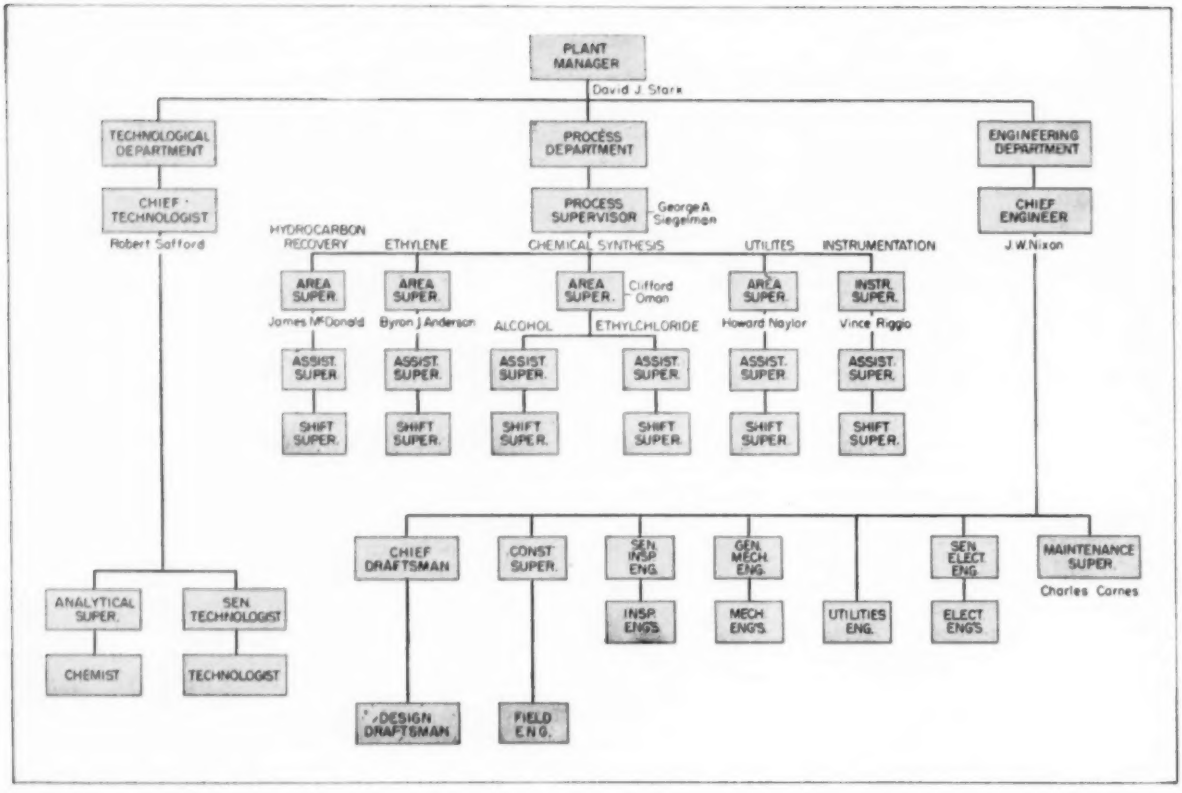
Finished products from this unit are 190 proof alcohol and diethyl ether. The 125,000 gal./day of alcohol represents about 30% of the nation's output of synthetic ethanol. The by-product ether production is 9500 gal./day.

Ethyl chloride production requires approximately 1,000,000 cu. ft./day of ethylene and 500,000 cu. ft./day of by-product hydrogen from the ethylene unit.

In addition to hydrogen and ethylene, chlorine is the other basic ingredient used in the plant. Chlorine is shipped in by tank car at the rate of a car a day. Chlorine storage facilities have been provided so that the plant may operate for approximately a week without further shipments. The plant includes a unit for burning chlorine with by-product hydrogen from the ethylene plant. This combustion is performed in Karbate furnaces. The products are recovered by absorption in muriatic acid and the hydrogen chloride is subsequently stripped prior to compression for the synthesis operation. This part of the plant is unique in that the materials of construction are a combination of Karbate and Haveg.

The ethyl chloride process combines hydrogen chloride and ethylene gases directly to produce approximately 50,000,000 lbs./yr. of ethyl chloride. The reaction vessels and compression equipment which are the heart of the process are followed by rectifying columns for producing pure anhydrous ethyl chloride.

The ethyl chloride produced will be suitable for tetra ethyl lead manufacture and other processes requiring a high purity ethyl chloride. Shipments will be made from the plant mainly by tank car.



ORGANIZATION CHART showing key personnel at Tuscola in manufacturing, maintenance and engineering

How Tuscola Trained Operators

IT TAKES people to operate a plant —and one of the problems National Petro-Chemical had at Tuscola was in getting trained personnel.

Since the plant is located in the middle of a rich farming area and remote from any industrialized section, very few experienced operators were available in the immediate vicinity. On the other hand, it was not desirable to go too far afield and import workers, both because of a desire to maintain good community relations and because local housing was rather limited.

A brief description of the program evolved for finding, hiring and training the required plant operators was included in a recent talk by James F. McDonald, superintendent of the hydrocarbon recovery unit at Tuscola, before a meeting of the Oklahoma section of AIChE. The balance of this article is a condensed version of Mr. McDonald's address:

To find suitable applicants, limited advertisements were placed in the Chicago and St. Louis newspapers, and in certain trade journals. However, for the most part, advertising was restricted to the nearby towns of Tuscola, Decatur and Champaign.

As a result, 1400 applicants were interviewed, from which 100 were hired as operating personnel. Out of this total, 40 were for the hydrocarbon recovery section. Eighty percent of these new employees lived within a radius of 30 miles of the plant-site and had no previous experience in either LPG or petro-chemical manufacture. This made it necessary to develop a very detailed training course to prepare the new employees for actual plant operation.

The new employees were given the following reputable tests:

(1) Purdue Research Foundation Aptitude Test

(2) Purdue Research Foundation Industrial Training Application Test

(3) Eugene J. Benge Basic Employment Test.

These tests were originally given to determine if any correlation could be found between the test results and later proven ability. As a result of this, these three tests are now given on a pre-employment basis to filter out unqualified applicants for this type of work.

Following these induction tests, employees received the following general training:

(1) *Orientation* — An introductory period of 18 hrs. was spent in acquainting the employees with company policies on labor, personnel routine, retirement and group insurance plans.

(2) *Safety* — A period of 10 hrs. was devoted to safety lectures, demonstrations and films on both accident prevention and first aid, with special emphasis on gas and chemical hazards.

(3) *Fire*—A period of 9 hrs. was spent on this phase. Fire prevention was handled in the classroom by films and lectures. Fire fighting was handled in the field by demonstration and drill with special emphasis on hydrocarbon fires.

DAVID J. STARK, plant manager, received his chemical engineering degree from the U. of Oklahoma, and before joining NPC was associated with Shell Oil Co. He was made process superintendent at Tuscola in September, 1951, manager last spring.

J. W. NIXON, chief engineer, joined the company in May, 1952. Prior to that time he was with Shell Oil Co. in an assistant manager's post. He holds a mechanical engineering degree from Princeton University.

GEORGE A. SIEGELMAN, process superintendent at Tuscola since February, 1953, spent 16 years prior to that with Shell Oil Co. His BS in chemical engineering was received from MIT and his MS in industrial engineering from Severs Institute.

ROBERT SAFFORD, chief technologist, came with NPC in his present position in October, 1951. Before that he was engineering supervisor of the Pittsburgh Consolidated Coal Co. He is a chemistry and chemical engineering graduate of Cornell and Yale.

JAMES McDONALD, superintendent of the hydrocarbon area, joined NPC in April of this year. He holds a master's degree in petroleum refining engineering, and before coming to Tuscola was process engineer for Phillips Petroleum Co.

BYRON J. ANDERSON became superintendent of the ethylene division in February, 1952, after serving as a senior chemist and senior technologist at the Calgary and Montreal refineries of Imperial Oil Ltd. He received his chemical engineering degree from the University of Alberta.

CLIFFORD OMAN, superintendent of the chemical area, is a chemical engineering graduate of the University of Minnesota. Before joining NPC in November, 1951, he was a sales engineer for the Elgin Softener Corp., and earlier was associated with Atlas Powder Co. and Shell Oil Co.

CHARLES CARNES, maintenance superintendent, took his present job in December, 1951. Prior to that he held several engineering positions with Shell Oil Co. A mechanical engineering graduate, he attended the Universities of Cincinnati and Houston.

VINCE RIGGIO, instrument superintendent, joined the company in April, 1952. Formerly, he was an electrical engineer with Union Electric of Missouri and installation superintendent with Monsanto Chemical Co. He is an electrical engineering graduate of the University of Washington.

HOWARD N. NAYLOR, power plant superintendent, took over his present post last February after serving 13 years as plant superintendent of the Kansas Power & Light Co. He joined the latter firm in 1924 after graduating from the University of Kansas.

(4) *Supervision and Discipline*—5 hrs. were spent on supervision, discipline and a discussion on the employees handbook.

The next step in the program consisted of 1-hr. lectures covering all of the basic subjects essential for understanding the underlying fundamentals related to the operation of a hydrocarbon recovery unit. The following indicates the scope of this training:

Absorption & Dehydration	2 hrs.
Chemistry	4 hrs.
Combustion	1 hr.
Control Testing	2 hrs.
Distillation	3 hrs.
Heat & Pressure	3 hrs.
Instrumentation	14 hrs.
Maintenance	11 hrs.
Process Equipment	4 hrs.
Production Control	1 hr.
Utilities	1 hr.
TOTAL	46 hrs.

These lectures were followed by written examinations from which it was possible to follow the individual progress being made.

Field trips throughout the plant augmented the formal classroom training. Qualified personnel conducted tours through the hydrocarbon recovery units, the chemical plants, the power house and the water treating plant. Here most of the operators came into visual contact with equipment they had never even heard of before.

Following the above preliminary studies, the personnel were split into three groups, viz. extraction unit, fractionation unit and loading and storage. The groups assigned to the operating units received further detailed instruction in plant start-up, normal operations, and shut-down procedures. The group assigned to loading and storage received instructions for that phase of operations.

At the conclusion of the above 60-day training period, operator classification and shift assignments were made. Classification was based on a careful examination of employment and classroom tests, attitude, personality, education, experience, age, and upon shift supervisors ratings.

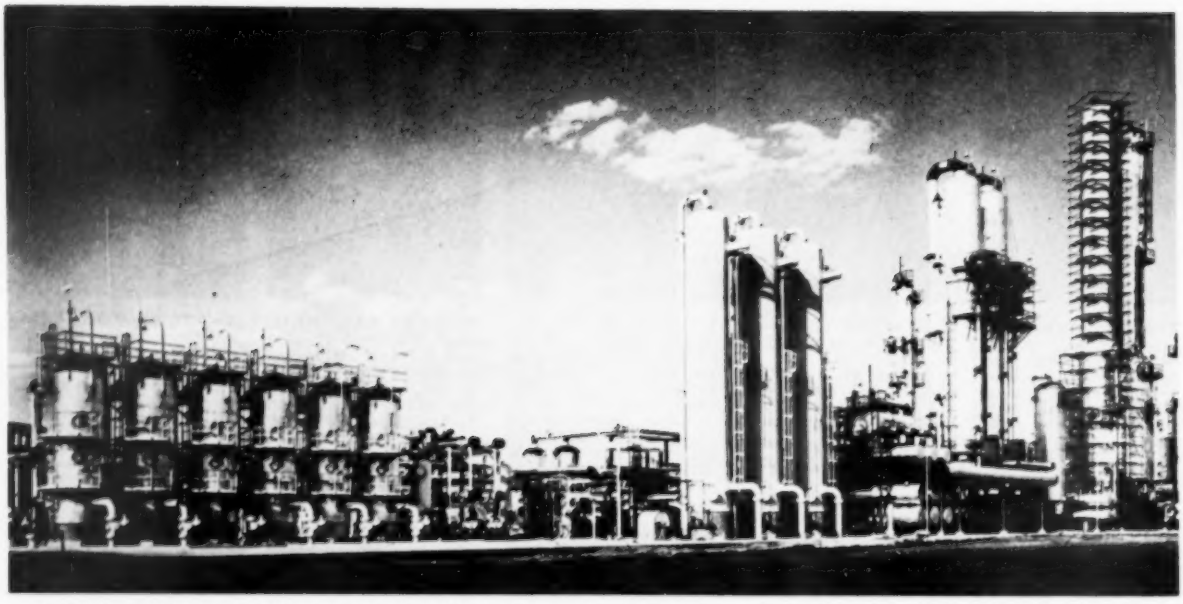
An important feature of the entire course was that each employee received complete operational training for the unit to which he was assigned. Each operator was thus given an equal opportunity to learn overall plant operation with a view to future promotion.

Results of the training period after three months of operations can be summarized as follows:

(1) The formal training plan was both suitable and adequate. As would be expected, experience is required at this time to develop the new men into A-1 operators.

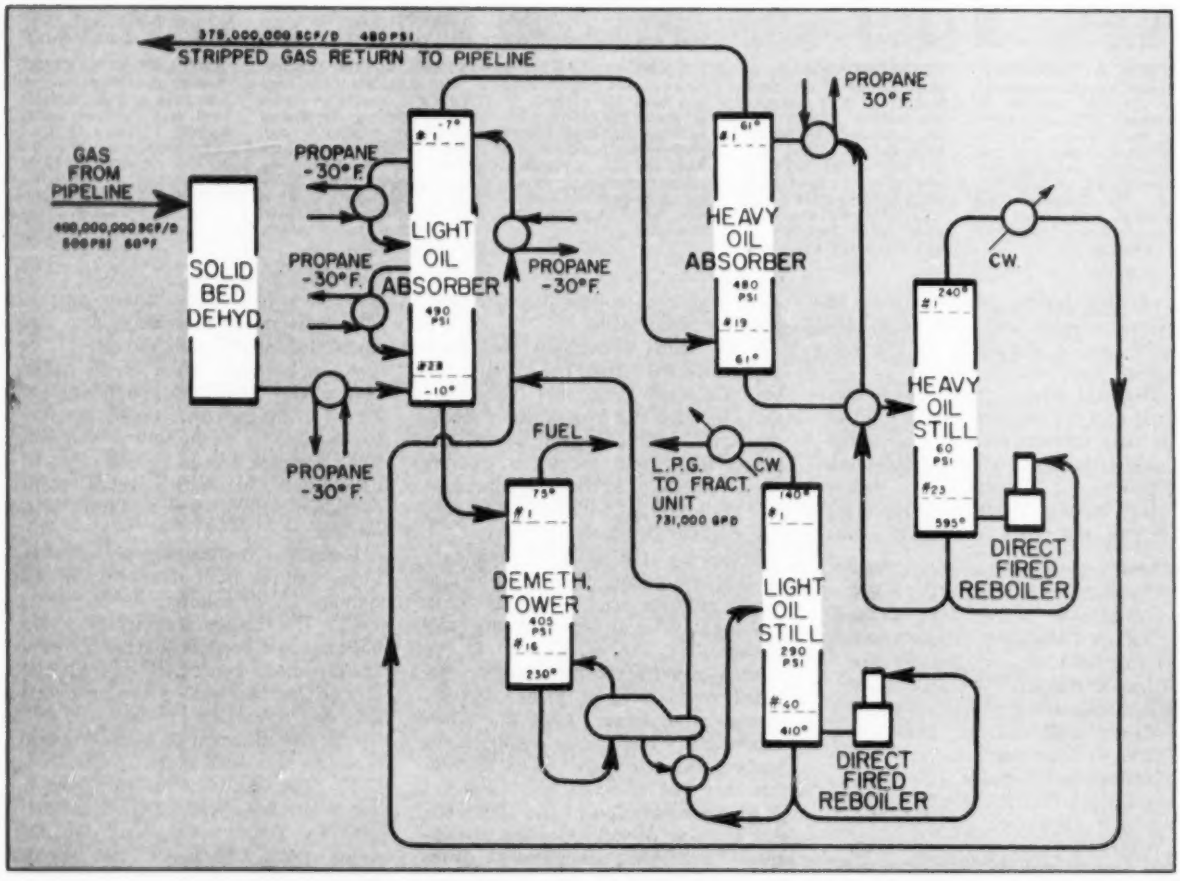
(2) Classification of operators into positions was well made.

(3) The results of the employment and plant tests will be used as part basis for future promotions. Qualification tests, experience and supervisors' rating will constitute the remaining basis.



EXTRACTION SECTION at Tuscola, showing dehydrators at left, light and heavy oil absorption towers and heavy oil stills

Hydrocarbon Recovery at Tuscola



FLOW DIAGRAM of hydrocarbon extraction unit; duplicated towers are not indicated

The problems involved in starting up the hydrocarbon recovery units at the new Tuscola plant of National Petro-Chemicals Corp. are described in the article below—a condensed version of a talk the author gave at a recent meeting of the Oklahoma section of AIChE.

A more complete description of the actual operation of the units was contained in an article published in Petroleum Processing last June, pp. 897-899—"Natural Gas to Ethane to Ethylene," by David Stark, plant manager. The flow diagrams from that article are included here for the reader's convenience.

By J. F. McDONALD
Supt., Hydrocarbon Recovery
National Petro-Chemicals Corp.

THE hydrocarbon extraction unit at the new National Petrol-Chemicals Corp. plant in Tuscola is a double oil absorption system. The recovery units have been designed to handle a maximum of 425,000,000 scfd of gas from the Panhandle Eastern Pipe Line Co. compressor station adjacent to the plant. A flow diagram of the extraction unit is shown to the right.

From this wet gas feed, the absorbers will extract 10,000,000 scfd of ethane (40% of the ethane present in the gas), and essentially all of the propane and heavier components, in the following quantities:

Propane	380,000 gas/day
i-Butane	21,300 gal./day
n-Butane	57,400 gal./day
Pentane	18,520 gal./day

Incoming gas from Panhandle Eastern is first dehydrated from a +45° F. dew point to a —100° F. dew point. The dehydrated gas is cooled by exchange and propane refrigeration to a temperature of —20° F. before it enters two light oil absorbers operating in parallel. A hexane cut which is used as absorber oil also is chilled to —20° F. before being charged to the absorbers.

Overhead from the light oil absorbers enters three heavy oil absorbers operating in parallel for recovery of the entrained light oil. The lean heavy oil employed has a molecular weight of 180. The stripped gas overhead is returned to the Panhandle Eastern Pipe Line compressor station.

Rich oil from the heavy oil absorbers flows to the heavy oil still where the light and heavy lean oils are separated. Reboiler heat is supplied by a direct fired heater.

Rich oil from the light oil absorbers goes to the demethanizer where the methane is removed. A reabsorber and preabsorber are required for the high ethane recovery.

The final step in the extraction unit is the separation of the extracted LPG and the lean light oil. This operation takes place in two light oil stills operating in parallel. The LPG is condensed overhead and sent to the fractionation unit for separation. The lean light oil is cooled by exchange before returning to the light oil circuit. Each light oil still is supplied with a direct fired reboiler.

The fractionation unit consists of four towers operating in series. Here the extracted LPG is separated into ethane, propane, isobutane, n-butane and pentane. The net make of ethane is sent to the ethylene unit as a vapor. The remaining hydrocarbons are sent to storage and are subsequently shipped to various sections of the country.

Initial Start-Up

When the time came to put the extraction and fractionation equipment on stream, the operators were first assigned the task of checking the unit for completeness, using mechanical drawings as a guide. Next followed a 100-lb. air test throughout the vessels and maze of piping. Despite previous hydrostatic tests on all equipment, numerous leaks were still found.

Reboiler furnaces were dried out for three days and most of the centrifugal pumps were run in on water. Several pumps seized during this period due to operator inexperience on multistage centrifugals. Investigation also showed some of the vertical type pumps had been shipped from the factory with the impellers not keyed to the shaft.

Factory representatives checked the centrifugal compressors and the steam turbine drivers. Governor trouble was corrected and some of the steam piping realigned and supported to give smoother running on the machines. Each compressor was run in at 400-600 rpm for several hours using air. The air was discharged throughout the refrigeration system to dry it out. The system was then gas purged, filled with propane, and alcohol added to the lower temperature surge drums.

This was followed by a gas purge over the unit. "Fyrite" oxygen analyzers were used to indicate the completeness of the purge. Panhandle gas was then cut in through the dehydrators, light oil absorbers, heavy oil absorbers and back to the Panhandle compressor station. The heavy oil system was circulated to supply heat to regenerate the dehydrators. The gas cycle was kept up for several days until the return dew point had dropped from +60° to —40°. It was of the utmost importance to remove all water from the system due to the low operating temperature level.

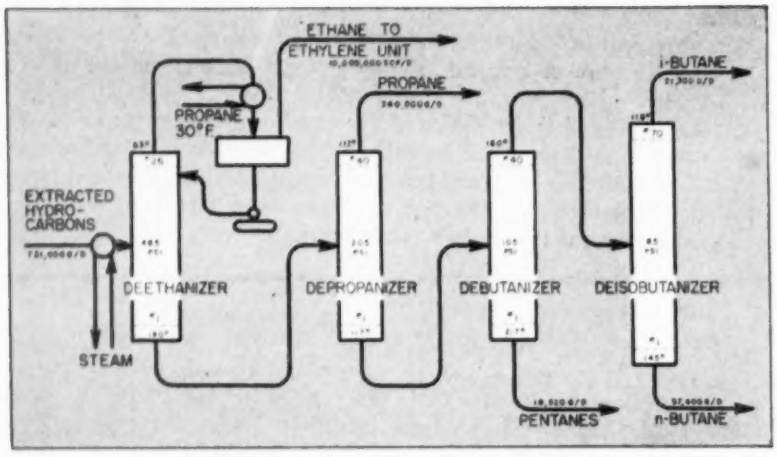
The gas cycle was cut off and the light oil circulating system started. During this period, the unit was continually drained at all low points for water removal.

The thoroughness in drying the unit out was indicated by not encountering any freeze up troubles in exchangers during the start-up. It had been anticipated some trouble would be encountered from this. In addition, good dehydration on the inlet gas is required to prevent hydrate formation, which is most difficult to remove from equipment.

Shortly after extraction operations had commenced, plugging on one set of the cold rich light oil—warm lean oil exchangers occurred. The plug, much to our dismay, was discovered to be Sovabead desiccant from the dehydrators. It was necessary to shut the unit down immediately and determine which dehydrator had lost its charge.

By blowing down the bottom of the dehydrators, one was found which discharged Sovabead. Upon opening this tower, it was found a small opening (1¼ in. by ⅞ in.) existed at the bottom support through which the desiccant passed down and was carried out by the incoming gas into the bottom of the light oil absorbers. Fortunately, the trouble was found before the Sovabead had been carried into all of the extraction unit.

As it was, 3-4 tons of Sovabead en-



FRACTIONATION UNIT flow diagram at Tuscola

tered the unit and several days were spent blowing and washing it out of absorbers, exchangers and lines. Sovabead lay around parts of the unit like snowbanks. To date, no further unfortunate incidents such as this have occurred.

All of the pumps are equipped with mechanical seals and initially these were a constant source of trouble. Small particles of rust, dirt, etc., and icing of the seals aggravated the situation. Adjustment of the spring tension and proper "O" ring installation solved some of the trouble. Steam tracing on the seal glands on another set of pumps has also helped. Seal trouble is still being encountered on occasions. Some mechanical engineers recommend using packed pumps during the first few months of operation and then replacing the packing with seals.

Bearing trouble was encountered on the motor drives on one set of vertical centrifugal pumps. This, at times, caused excessive vibration and the pumps had to be shut down. This problem was solved by installing a heavier type bearing which was able to carry the load.

To date, considerable mechanical difficulty has existed on the centrifugal compressor installation. Two 4,000 hp units operate in parallel at 7500 rpm on the extraction unit. These provide a refrigerating capacity equivalent to the manufacture of 4850 tons of ice per day. Propane is vaporized into various stages of the same machine rather than having separate compressors. Separate suctions are provided for each of five stages, namely, —30°, —20°, 27°, 48° and 70° F.

Initially, only one machine was placed in operation. Four of the suction lines and the discharge line contain butterfly valves. When the steam turbine ring pressure drops to 200 psi, a solenoid valve goes into action and the butterfly valves close. This installation was made to prevent reversal of rotation on the compressors when being shut down.

On one occasion, the machine stopped for some undetermined reason. When discovered, the machine was reversing at a high rate of speed. It was also noted that the linkage on the butterfly valves had slipped and so did not close.

The reversal of rotation burned out the thrust bearing on the turbine drive. The bearing was rebabbited and the machine placed back in operation. After a few days, the thrust bearing housing became hot and again the machine was shut down. Inspection revealed the bearing was badly wiped. It was also discovered that due to too much play in the shaft the turbine blading had been badly damaged by jamming against the guide vane. The rotor was returned to the factory for the necessary reblading.

Check valves were then installed in the oil line on the turbine drives to prevent the oil from being sucked from the thrust bearing during reverse rotation. This move has been very successful and a positive oil pressure is now held on the bearings during reverse flow. The compressor representatives have stated this type of flow is not harmful to their machines.

Another improvement was made by reducing the closing action on the butterfly valves from a 25 sec. period to only 1 sec. Even with this fast action reverse flow is still experienced when a machine is shut down. However, with the previously mentioned check valve installation, the thrust bearings no longer burn out.

Another difficulty experienced was the rupture of expansion bellows on the compressor discharge line. Three such failures occurred over a period of eight weeks. Piping calculations were then made which indicated the expansion joints were not needed. They have since been replaced by solid piping. Two of the suction lines were equipped with the same type of joint but, to date, have not failed.

The operation of the 4,000 hp refrigeration compressors is very unstable when two units are placed in parallel operation. When the second unit is cut in, surging, excessive vibration and a decrease in refrigeration capacity results.

The following procedure is now used when bringing the second unit on line:

1) The speed of the machine in operation is reduced from 6200 to 5500 rpm. The critical is reached at 5300 rpm so that the speed cannot be reduced as much as desired.

2) The vapor load is increased by by-passing the discharge back to the suction drum. This decreases the possibility of "starving" the main 20-in. suction line, which is a common header for both machines.

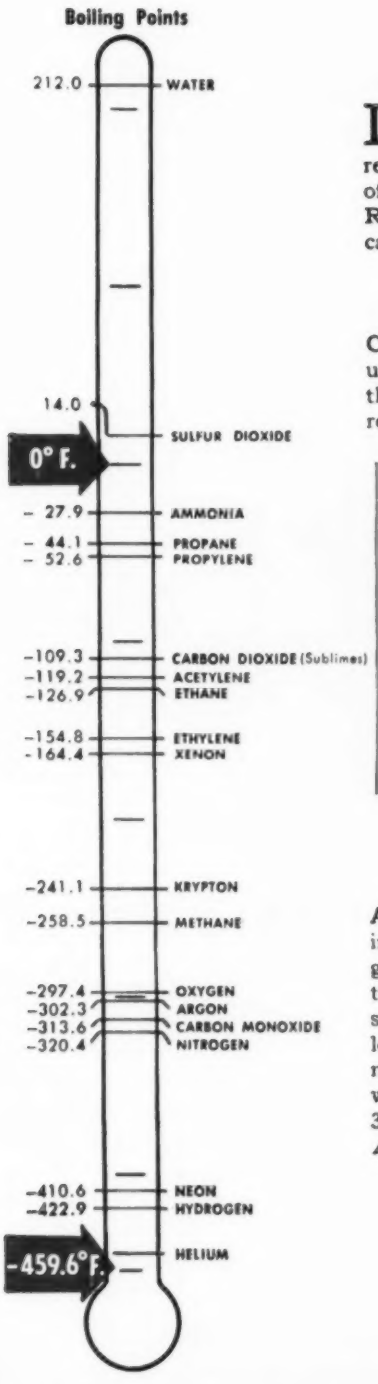
Initially, the attempt was made to balance the load by closing or opening the suction valve positions on each machine. However, with five suctions to each machine, this "juggling" act proved impractical.

3) The main suction pressure is then decreased slowly. This is done by gradually speeding up both machines and cutting back on the recycle. Surging occurs during this operation and very close operator attention is required. Any slight upset on the unit which lightens the refrigeration load will also cause surging even after the machines have been lined away.

One other incident concerning the cooling water system is worth referring to at this time. The hydrocarbon extraction system has its own cooling tower, with make-up water being purchased from a private water treating firm. At the start of operations, it was impossible to keep the pH of the tower basin within control limits. In fact, the pH ran from 3-4 for several days.

Finally the trouble was found to be the make-up water, which was periodically running acidic due to a faulty pH meter. The acid water did a very good pickling job on the circulating water piping, which resulted in a shut down to clean the tubular equipment. Considerable mill scale was accumulated in the heads and tubes although little indication of any corrosion was found.

NEW PROFITS thru Low-Temperature Liquefaction and Separation of Gases



Take Dollars out of By-Product Gases, Natural Gas, Air; Cut Storage Costs

Low-temperature processes open new profit possibilities for the chemical, petroleum, steel and related industries. They make it feasible to recover valuable products from many gas mixtures . . . or, used in place of other recovery methods, widen profit margins. (See examples in chart.) Reduced to a liquid state by low temperatures, gases such as natural gas can also be *stored* at less cost.

What Can Low Temperatures Do For You?

Consider your fluid flows, or mixtures you now dispel or burn as waste, use for fuel, or can get at low cost (natural gas) or *no* cost (air). Can these "resources", plus low-temperature processing, provide additional revenue?

SOURCE	PRODUCT	SOURCE	PRODUCT
Refinery gas Natural gas Coke oven gas Cracked products	Hydrogen Ammonia synthesis gas Methane Ethane Ethylene Propane	Refinery fluids	Dewaxed oil Benzene Toluene Xylenes
Cracked products	Ethyl benzene	Ammonia purge streams	Argon
Air	Oxygen Nitrogen Argon	Reactor gases	Sulfur dioxide
		Carbon dioxide	Dry ice

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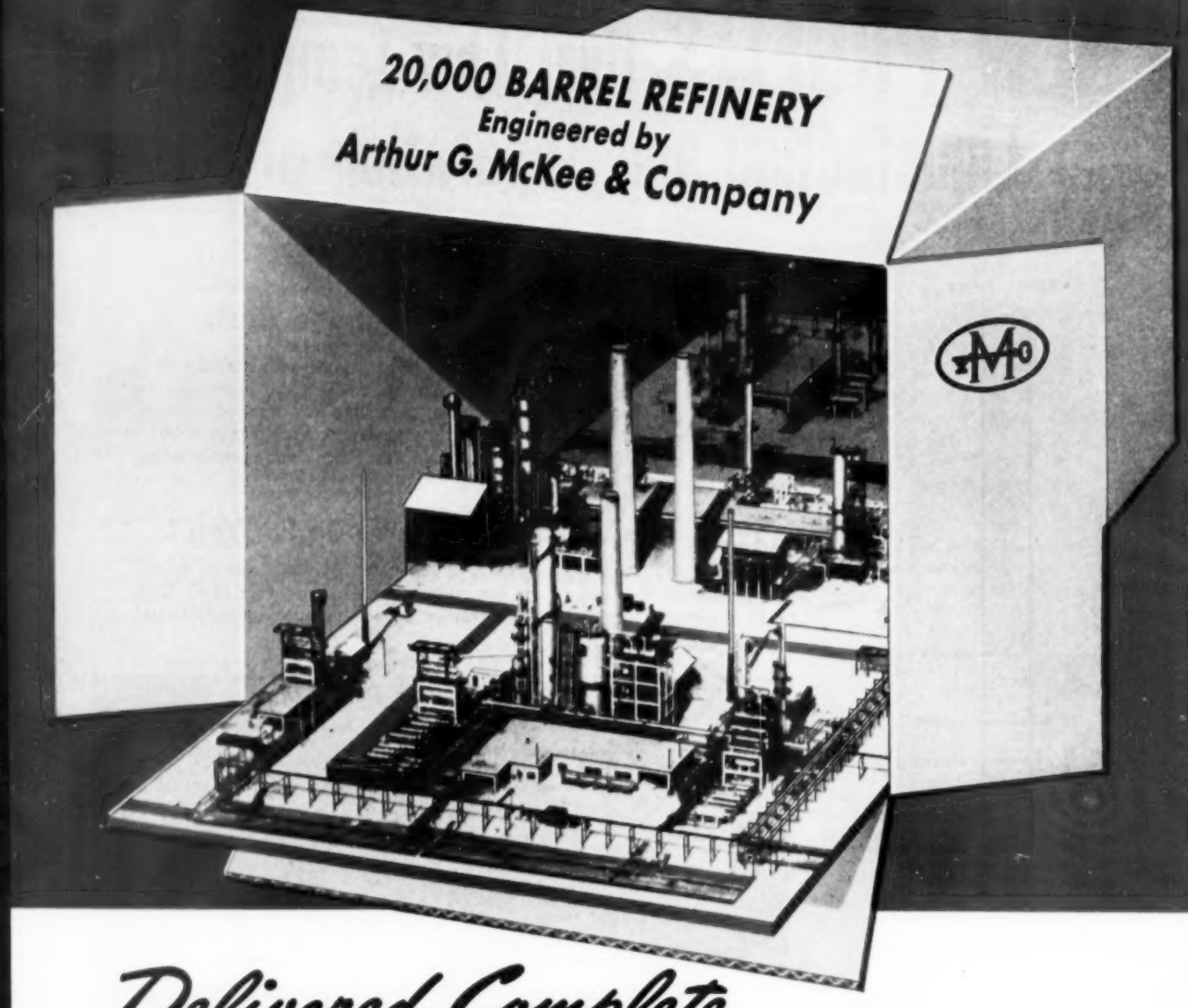

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Having process analyzer problems?

Here's a list of things you may need:

Proper sampling point location
Planned piping layout
Filters
Scrubbers
Agglomerators
Vaporizers
Closer control of physical variables

Trouble in Your Sampling Systems?

A GOOD sampling system for process analysis instrumentation is not just a simple, straightforward job of piping the sample from the process stream into the analyzer according to petrochemical plant instrument engineer S. B. Spracklen of Carbide & Carbon Chemicals Co., South Charleston, W. Va.

Some ideas as to the general problems of proper sampling were brought out in a paper Mr. Spracklen presented at the 8th National Conference of the Instrument Society of America in Chicago in September.

Many analyzers are being installed today just as a simple piping job, he said, and results are most discouraging. Although the manufacturer's representative follows up the sale of such instruments with engineering aid for correct installation, too many obstacles prevent success. He rarely has intimate familiarity with the process the instrument is to serve. In many instances, the process is in the development stage and cannot be discussed. Further, the representative frequently does not have sufficient time to make a complete study of every installation.

A good sample must be both measurable and representative. A measurable sample is one that will not alter or adversely affect the accuracy of the analyzer and one in which all variables affecting the measurement are either compensated for or held substantially constant with respect to the physical property being measured. A representative sample is one that has been correctly sampled, filtered, and physically conditioned without altering or changing the variable factor that is to be measured.

What are some factors that will help provide a good sample? As outlined by Mr. Spracklen, they include:

1—Proper location of the sampling point.

2—Filtering to remove unwanted solids and prevent plugging.

3—Scrubbing to remove corrosive gases and condensible vapors.

4—Agglomeration to remove entrained droplets from gas streams, or gas bubbles from a liquid stream.

5—Careful control of temperature, pressure, and flow rate.

Choice of a sampling point requires knowledge of the physical and chemical conditions of the process stream. The sample may not be properly representative if the sampling point is incorrectly located.

As an example: in the measurement of density or refractive index of a liquid; results would be erroneous if the sampling point were on the top side of a piping system in which gas bubbles are trapped and funneled into the system.

On the other hand, when sampling a gas stream, it is good practice to sample from the top side of the piping system to minimize the amount of condensates and solids that are admitted to the sampling system.

In a liquid stream where laminar or viscous flow is known to exist, the most representative sample may perhaps be obtained by extending the sampling tube to the center of the pipe rather than using a normal pipewall tap.

Another problem may occur if sampling lines are too long, because they can introduce an excessive time lag between the process stream and the analyzer. Sometimes, analyzers have been designed for installation at the sampling point, but with the indicator or recorder at another or more convenient location.

The volume of the sample must be kept to a minimum and the flow velocity in the sampling system must be high, if it is desirable to have the instrument respond to rapid fluctuations of a variable in a process stream. Conversely, if the average value of the variable is the result desired in a process where rapid fluctuations occur, then receivers or surge tanks are recommended.

In gas systems where long sampling lines are a necessity, pressure reduction to 15 psi. or lower at the point of sampling is advised as a means for reducing the time lag.

Filtering prevents plugging of the sampling system or the sample cell. Although most analyzing instruments include protective devices it is up to the plant instrument engineer to provide protection for the sampling system, and its components — orifices, pressure regulators, and the like.

Selection of the filter necessitates attention to the following points:

1—Surface porosity must be such that it will not plug up itself.

2—Length of service expected depends on percentage solids in the sample stream, their size, sample flow rate, and surface area of filter.

3—Net volume of filter must be kept low to minimize effects on response time lag for changes in the process stream to get to the instrument.

4—Filter material must not be chemically reactive with sample.

5—Filter units should be interchangeable without requiring disas-

sembly of the piping system.

Scrubbing devices help prevent possible damage to the analyzer or inaccuracies in measurement because of corrosive gases and incondensible vapors in the sample stream. Selection requires the same attention as is given to filters, although the types of scrubbers are somewhat more limited. Generally, gas from the sampling system is scrubbed by contact with a liquid, usually aqueous solutions varying in concentration from strong to weak acids or bases.

In the sparger type, the gas enters the scrubbing medium at the bottom of a column through a sintered disk. The small diameter of the holes in the disk breaks the gas up into very tiny bubbles, providing high surface contact and good scrubbing efficiency.

Disadvantage of this type is the possibility of foaming (from the very small bubbles) and resultant carry-over of liquid droplets. This may require an extra entrainment separator in the line following the scrubber.

The packed tower type scrubber is probably the most widely used. Choice of packing material determines extent of surface area for contact between gas and liquid; however, contact is over a somewhat greater length than with the sparger type. Here, again, liquid carry-over can occur, but baffling or entrainment separators help.

The gas-lift type scrubber is suited particularly to applications where precipitates are formed in the scrubbing. In this type, the gas sample travels concurrently with a stream of the scrubbing liquid through a relatively narrow tube. At the top, the gas and liquid are separated by baffles, with the liquid returning to a reservoir to be used again. A filter in the liquid line to the reservoir removes the precipitates.

Agglomerators remove liquid droplets dispersed in the gas sample. They may take the form of cold traps, baffles, sintered disk filters and centrifuges. The simplest to construct and most widely used is usually nothing more than a cylinder packed with glass wool. Gas enters near the top and flows down through the wool to a point near the bottom. There the gas flow reverses in direction and passes up through a tube in the center of the unit and on to the analyzing instrument. Liquid collects on the glass fibers and drains to the bottom, where it accumulates and is dumped through an automatic float valve.

An agglomerator will also serve to remove entrained gas bubbles from a liquid sample stream. In this case, the liquid enters near the bottom and flows up through the glass wool. The gas bubbles collect on the fibers forming large bubbles. These break away from the fiber and continue on to the top of the unit. There, the gas is separated from the liquid sample and vented from the system.

Temperature effects in liquid analysis—Temperature control is essential to a sampling system because of the effect of this variable on the number of molecules present in the sample cell and the fact that a quantitative measurement is a function of the number of molecules. Most liquid analyzers have built-in temperature compensation.

With uncompensated instruments, there is the problem of determining the temperature coefficient. If this value is small—say, less than 1% of full scale per ° C., temperature compensation or control is necessary only if the instrument experiences large temperature variations.

If the coefficient is large—say 5% per ° C.—both temperature compensation and control may be necessary for both instrument and sample stream.

Errors in measurement can, however, be introduced by temperature control of the sample. For example, heating can cause bubble formation, polymerization, decomposition, and possibly hydrolysis. Caution must therefore be exercised in such instances.

Temperature effects in gas analysis—In a gas analyzer, the number of molecules in the measuring cell is inversely proportional to the absolute temperature. Also, for most gas analyzers, the measurement is exponential for changes of the number of molecules in the measuring cell.

Therefore, two non-linear variables are introduced as errors in the measurement when the temperature of the gas in the measuring cell varies. Whether that temperature can be controlled will depend upon the accuracy of the measurement required, the temperature coefficient of the measuring cell, and the temperature variations without control of the sample and the cell.

The temperature coefficients usually range from about 0.2% to several % per ° C., and gas sample temperatures may fluctuate as much as 50 to 60° C. Therefore, the gas sample will require temperature control in the majority of cases for the instrument to have an accuracy of 1% of full scale or better.

Steam-heated vaporizers, though commonly used in many plants because of the ready availability of steam, have a number of shortcomings. Many liquids, when vaporized at 100° C. or higher, will polymerize or change chemically. This causes plugging of the sampling system and may introduce measurement errors. Also, vaporization of higher boiling fractions presents the possibility of subsequent condensation in a cooler portion of the sampling system or the instrument.

For samples containing a polymerizable liquid and a low content of high boiling fractions, a somewhat more complex vaporizer is suggested.

This type of unit consists of a vertical cylindrical vessel containing two coils of tubing. One coil, extending the full height of the cylinder, carries the sample stream. The other coil, at the lower end of the cylinder and intertwined with the first coil, carries steam. The vessel itself contains freon as a heat transfer agent.

This vaporizer was designed to serve also as a temperature controller of the sample stream. Its temperature is maintained slightly lower than that of the sample cell in the analyzer. The freon is heated and temperature controlled by the steam coil and a thermally regulated steam valve. The freon liquid boils and its vapors rise to the upper coil or flash vaporizer, where it condenses again.

The sample enters at the top, is flash vaporized, and flows down through the coil. High boiling fractions in the sample stream that are not vaporized flow into a liquid trap at the bottom and are returned to the process system. The gas vapors are brought to a fixed temperature and pass on through an agglomerator to the analyzer.

If the high boiling fractions are large—say 5% or more—and if polymerizable liquids are present, a vaporizing system is suggested. This system requires a back pressure regulator, two gas metering pumps, a temperature controlled condenser, and a pressure regulated inert gas supply in addition to the vaporizer.

Its purpose is to vaporize all the liquid, remove the high boiling fractions, and replace them with an equal volume of inert gas and, therefore, to deliver to the analyzer a sample containing the same vol.-% of low boiling fractions as was obtained from the process stream.

The entire system is temperature controlled with the vaporizer and metering pump No. 1 maintained at a temperature high enough to assure complete vaporization of the liquid, and with the condenser and metering

pump No. 2 maintained at a lower temperature than that of the sample cell. Gas pressure at the outlet of the vaporizer is controlled by the back pressure regulator and at the same value as the inert gas supply to the condenser.

Metering pump No. 1, operating at a fixed temperature and pumping a fixed volume, delivers to the condenser a metered volume of gas containing a given vol.-% of constitutent A and the high boiling fractions. In the condenser, the high boiling fractions are condensed, leaving a higher vol.-% of constituent A. The condensing action lowers the pressure and allows the inert gas to flow into the condenser in an amount equal to the volume of the high boiling fractions. The outlet of the condenser connects into metering pump No. 2, and the gas flow is pumped at a rate equal to the inlet to the condenser corrected for the temperature difference across the condenser.

Flow rates must be controlled where fluctuations may cause variations in temperature in the sample cell, particularly with liquid analyzers, where effects of pressure changes are usually negligible.

A weir type flow controller is the least expensive and probably the most widely used. This type is applicable where viscosity or density do not vary too much. In this device, a fixed hydraulic head is obtained by feeding more liquid into the weir than the analyzer requires. This causes the excess liquid to rise to an overflow pipe, with the remainder going through a flow orifice to the analyzer.

An even simpler flow controller is made up of a pressure regulator and an orifice. The regulator is a non-bleed type with pressure taps on both sides of the regulator diaphragm. A wide variety of orifices can be used; however, better flow regulation is obtained as the diameter and length of the flow restriction is increased. Like the weir type, this controller is subject to variation in flow with changes in liquid viscosity and density.

A positive displacement pump for metering flow control is a third technique, and one which obviates the effect of viscosity and density changes.

A final problem in sampling systems, particularly in the case of gas streams, is to get the sample out of the analyzer without affecting the measurement adversely.

It is not good practice to vent the outlet of a gas analyzer into the common plant vent system, because of back pressure fluctuations in such a system.

Do You Know These Words?

By B. H. WEIL
Manager, Information Services
Ethyl Corp. Res. & Engrg. Dept.
Detroit, Mich.

A regular department intended to help administrators and operating men alike keep abreast of technical names and processes in the petrochemical field.

Epichlorohydrin

Epichlorohydrin, which has the formula CH_2OCHCH_2Cl, is a petrochemical that today faces a rapidly expanding market as an intermediate in the manufacture of anticorrosive coatings and versatile adhesives.

A volatile, narcotic liquid with a chloroform-like odor, it is heavier than water, and it boils above and freezes below the temperature range for this substance. It is pronounced "**ehp**-ih-**klo**-ro-**high**-drihn."

Epichlorohydrin is produced from propylene as an intermediate in the synthesis of glycerine. Propylene obtained from refinery cracked gases or produced by the cracking of propane is chlorinated in the vapor phase to yield allyl chloride, which is then chlorohydrinated (reacted with hypochlorous acid) to give a mixture of dichlorohydrins. On dehydrochlorination, these yield epichlorohydrin.

Uses include application as a solvent for cellulose esters and ethers, gums, and resins, and as an intermediate for lacquers, paints, varnishes, coatings, and adhesives. One of the most important of its growing uses is in the synthesis of the versatile epoxy resins, where it is reacted (usually) with bisphenol (another petrochemical) to yield the required monomer from which the plastics are produced. These resins are exceptional coating agents and adhesives, and as a reinforcement for glass fiber are of potentially vast significance in the field of plastic pipe lines and oil tanks.

Until recently, epichlorohydrin was chiefly produced by only one company but one or two others are now said to be at least planning to enter the field. As a petrochemical intermediate for further synthesis, epichlorohydrin will apparently be used and produced in greater quantities in the future.

Amyl Alcohols

Amyl Alcohols, once produced almost exclusively by the fractionation of fusel oil (itself recovered from the alcoholic fermentation of agricultural materials), were among the first commercial petrochemicals. Only now (1953), however, has their production reached the point where tank-car quantities of the synthetic "mixed primary" amyl alcohols are regularly available.

All the amyl (pronounced "**am**-uhl") alcohols have the formula $C_5H_{11}OH$. There are several with this same formula, however, because (by at least one process) they are derived from a mixture of pentane isomers (chemicals with the same formula but different molecular arrangements), and because this method of synthesis also introduces reactions leading to a variety of isomers.

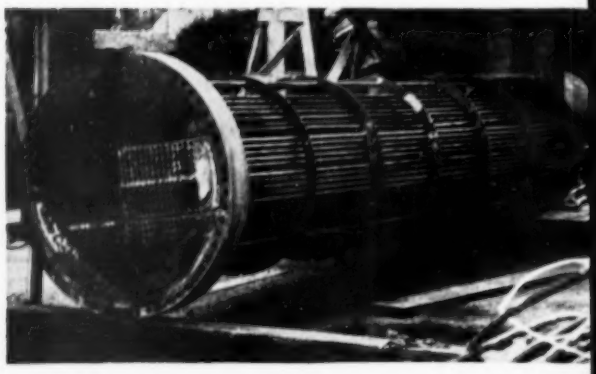
All are of commercial significance, but the primary alcohols (those which have the alcohol group attached to an end carbon atom) are the ones which are finding the most important applications.

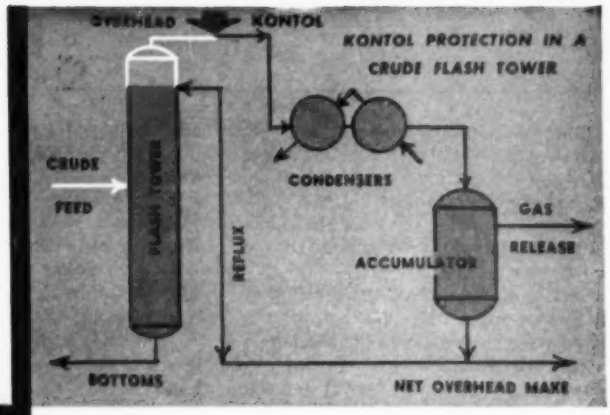
The mixed primary amyl alcohols produced by Sharples Chemicals, the pioneer in this field, are water-white liquids that boil between 127.5° C and 140° C and have a flash point of 100-125° F. They are produced synthetically by the chlorination of pentane followed by hydrolysis and distillation. If desired, further distillation and processing can be employed to obtain such specific alcohols as normal amyl alcohol.

These alcohols are employed by the manufacturers of plasticizers, additives for lubricating and fuel oils, esters, mining chemicals, and synthetic lubricants. They are petrochemicals in every sense of the word, since their basic raw material, pentane, is obtained from natural gasoline or refinery gases.

Amyl alcohols may also be obtained as a by-product from the Synthine (Fischer-Tropsch) synthesis of gasoline from natural gas or coal, or by direct synthesis via the related Oxo process. It appears probable that the mixed alcohols and/or specific isomers will find increasing markets.

PROTECT AGAINST REFINERY CORROSION





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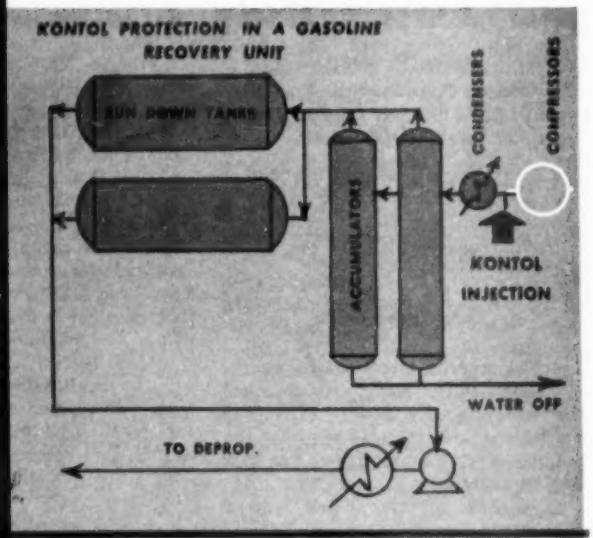
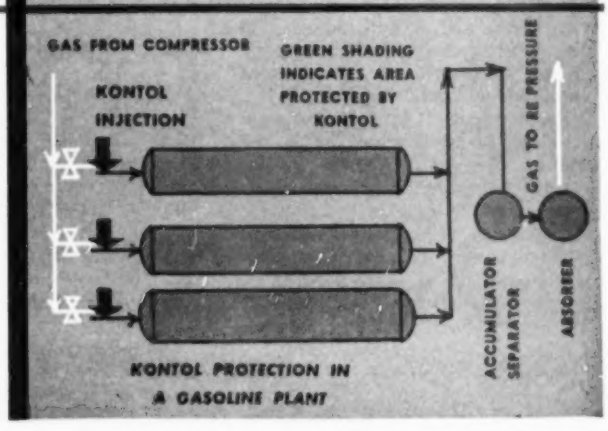


*Kontol is an excellent corrosion preventive in natural gasoline plants, too.



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(To obtain more data on advertised products see page 1936)

ACCURATE GRINDER for thermowells. Complete assembly at left; exploded view at right

Simple Tool Grinds Thermowells True

By JAMES W. ROSS*
Gulf Refining Co.

HOW many times have you ground in a thermowell, only to find that it leaked after operations were resumed? This is especially true when an old-fashioned T-wrench has been used on long wells, because you are unable to hold the well in an accurate position for a true grind.

The simple device illustrated in the photograph will assist in grinding in any well regardless of length or angle. Made up of pieces of scrap, it has only four major parts.

The handle was made from a discarded valve stem, ½ in. in diameter by 12 in. long, bent in the form of a crank handle. One end has 1-in. standard bolt threads and is screwed into the well. A locknut is screwed on this shaft for locking the well to the crank.

The second piece, a discarded thermowell adapter screw, was turned out with following dimensions: overall length, 2 in., with five threads left on and the hexagonal head turned down as illustrated. For a better grip, the adapter screw should be knurled. The hole in the adapter screw is enlarged to ½ in.

A hole, 1 in. wide by ½ in. deep, was bored into the lower portion of the adapter screw so that the third piece, a small loading spring of 1 x 3 in. size, could be inserted. This spring applies pressure to the well.

*Mr. Ross is an instrument repair man for Gulf Refining Co. at its Cleves, Ohio, refinery, and a previous contributor to these pages.

Answer to a Flare Corrosion Problem

THE following item, presenting a suggested solution to a corrosion problem in a refinery flare tip, is based on information developed in a conference at Montreal for representatives of several Canadian oil companies and of International Nickel Co. of Canada Ltd. It was prepared for PETROLEUM PROCESSING by John F. Mason, Jr., corrosion engrg. section, development and research dept., International Nickel Co., New York. A major portion of Mr. Mason's work appeared in the September issue, pp. 1332-1335.

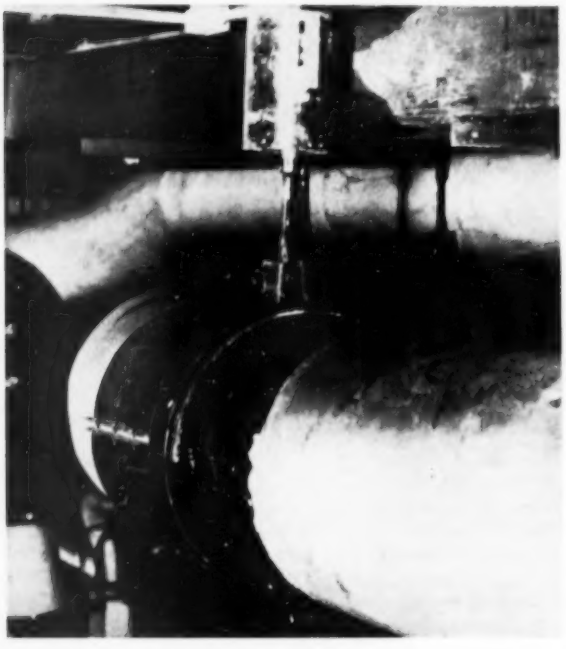
Problem: What is good practice in materials for waste gas flare tips? The flare in question burns 5 tons daily of hydrogen sulfide, plus any hydrocarbons resulting from upset plant conditions. Previous stack tips were constructed of Type 304 stainless steel and have required repair annually for the past four years. They were badly deteriorated, and it is now proposed to install a very simple flare tip of 28-8 chrome-nickel alloy casting.

Suggested solution: Because of the corrosiveness of refinery waste gas or flare gas upon ignition, and the high temperatures involved; carbon steel has proved to be an unsatisfactory material for the tips of such stacks.

The use of alloys is indicated and, as a matter of fact, 18-8 stainless steel is used to some extent in this service. However, it has not worked out to be entirely satisfactory and in some cases failures have occurred in a matter of six months. Types 310, 309, and Inconel have been used with good success. Experience with Inconel, in particular, has indicated it to be highly useful for flare tips.

Standard Oil Co. (Ohio) has patented an especially designed flare tip for which they have standardized in the use of Inconel. A description of one of these installations appeared in PETROLEUM PROCESSING, July, 1950 (pp. 736-738). Their experience with the failure of 18-8 stainless steel in a relatively short period of time led them to an extensive survey of materials of construction available for such service.

How to Save on Supporting Insulated Piping



A different method of hanging insulated pipe, used in a recent Union Oil Co. of Calif. project, helps to reduce costs from heat losses as well as installation expense.

Whereas pipe hangers generally are fastened to steam transmission or hot process piping *before* thermal insulation is applied, at Union's new research laboratory at Brea, Calif., pipe hangers were installed *after* the insulation had been applied. The procedure not only simplifies the insulation work, but more importantly, it avoids direct metal-to-metal contact between hangers and hot piping. As a result, conduction losses through the hangers are eliminated.

Tests have been conducted at the University of Illinois to show that with properly designed hangers, 85% Magnesia insulation will bear safely a load of 10 psi., or 100 lb./running in. of supported main. A band of 10-gage steel plate, with length proportional to the load to be carried, is secured around the insulated piping at hanger points. To help distribute the load and permit pipe movement caused by expansion, a ⅜-in. thick steel saddle plate is tack welded to the lower portion of the band.

In some cases, banks of piping are supported by angle irons or channels instead of individual pipe hangers. It is recommended that a simple 16-gage sheet metal jacket, about 18 in. long, be fastened around the insulated piping at the supports for this type of installation.

—*Magnesia Insulation Mfgrs. Ass'n.*

Tips on Ball Bearing Maintenance

AN important part in the service life of an electric motor or a pump is played by shaft bearings. Proper fit, installation, and lubrication are all important factors in obtaining good service.

For the past two months, a series of questions and answers dealing with this problem have been presented. They were a portion of a seminar conducted at the Aruba, Netherlands West Indies, refinery of Lago Oil & Transport Co. by Mr. Jack Cannon of Continental Electric Co. and made available to PETROLEUM PROCESSING by Lago.

The problem of installation and removal is covered in this month's questions and answers:

What objections are there to using tubing to drive a bearing on a shaft?

It is practically impossible to keep the inside of tubes or pipes clean. They will scale continuously; and if a small piece of scale gets into the ball bearing or the grease, it will cause bearing trouble. Because the tubing or pipe is only slightly larger than the locknut threads, it is again almost impossible to avoid striking the top of the threads which will cause a splinter of steel to go into the bearing or the grease.

What is the best kind of hammer to use with a cold-rolled steel drift?

A standard, forged steel, ball-peen machinist's hammer.

Is it necessary to put white lead on the shaft before putting on a bearing?

No.

Why not fasten the inner race on the shaft with a key?

This is not necessary because a metal-to-metal fit between the shaft and inner race will prevent any bearing with the proper internal looseness from turning on the shaft. Furthermore, the inner race metal is so hard that you could not put a key-way in it.

Why do you need the amount of play you get when you have a drop-fit in a bearing housing?

When you are assembling a bearing or shaft into a housing in the shop, everything is at the same temperature. However, when the pump or motor is finally installed on the job you want the various fits to be proper with the pump or the motor running under load.

Because heat will flow from the pumpshaft into the inner race of the ball bearing and then through the balls into the outer race, you get an expansion of the outer race that you did not have when you assembled the pump or motor in the shop. You must allow for this expansion beforehand. The play or clearance that you had between the outer race and the bearing housing with a drop-fit will disappear under the operating temperatures. The result will be a fine, snug fit for the outer race in the housing.

Do you have to be careful when you install a bearing on a slow-speed pump or motor?

You should be careful and follow all the rules when you install any new bearing. Naturally, the bearing does not require as much internal looseness when operating at slow speeds. Nevertheless, the fit on the shaft and in the housing should be done with all the care you know. Try to install all bearings as if they were going to operate at 3600 rpm.

Should a bearing be installed in a shaft that is tapered?

No.

Why should you always remove the tang of a lock washer that was previously used?

Lock washers are made of soft steel, and will not take many bends. Usually

Bearing Maintenance Tips

(Please begin on page 1903)

the third bend will break off the tang. When the lock washer was last used, someone bent the tang down. Then you had to bend the tang up in order to remove the locknut. If you should use the same tang when installing a new bearing, it will be ready to break off. This piece of metal, loose in the bearing housing, will easily cause a bearing failure.

Should locknuts be tightened with pin-punches or drifts?

No. There is too much danger of moving metal in the slot of that locknut. A piece of this moved metal can get into the ball bearing and cause a failure. It is not necessary to tighten locknuts that far.

Do ball bearings have to be broken in?

No. Ball bearings are ready for service once they are properly installed. If a bearing runs hot it is not breaking in: it was not installed properly.

Is it dangerous to pull off (remove) a ball bearing with a gear puller? Will the bearing "explode"?

It should not be dangerous to remove a ball bearing from a shaft with a typical gear puller. Common sense should indicate that if sufficient force is used on the gear puller and the bearing will not move, then it is entirely possible to break either the bearing or the gear puller. Ordinary safety precautions suggest that a tight bearing should be covered with heavy canvas while great forces are being applied to remove it.

Just how can you remove a ball or roller bearing from a shaft?

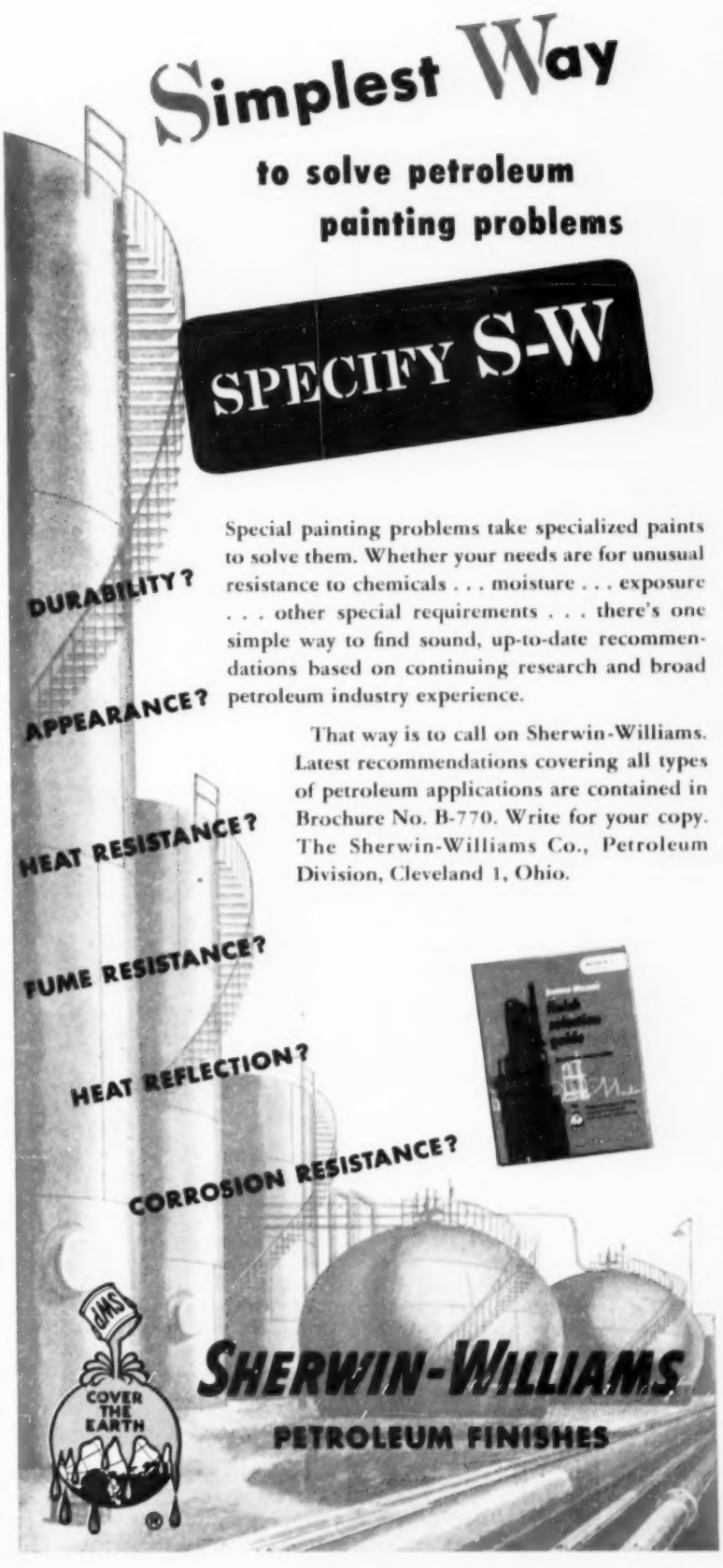
Here are a few suggestions: Only remove a bearing if you intend to replace it with a new one. It is almost impossible to remove one without doing some damage.

A three-jawed puller is better than a two-jawed puller.

Always insert a "floating center" between the shaft and the point of the screw of the puller.

If a bearing has failed so much that the balls and inner race have lost their hardness (if you can "touch" the inner race with a file), put the shaft in a lathe and turn off the inner race with a Carboloy tool bit.

Burn off the inner race only as a last resort because you will always bend the shaft when you apply that much heat to it. That means the shaft has to be straightened in your machine shop before it can be used again.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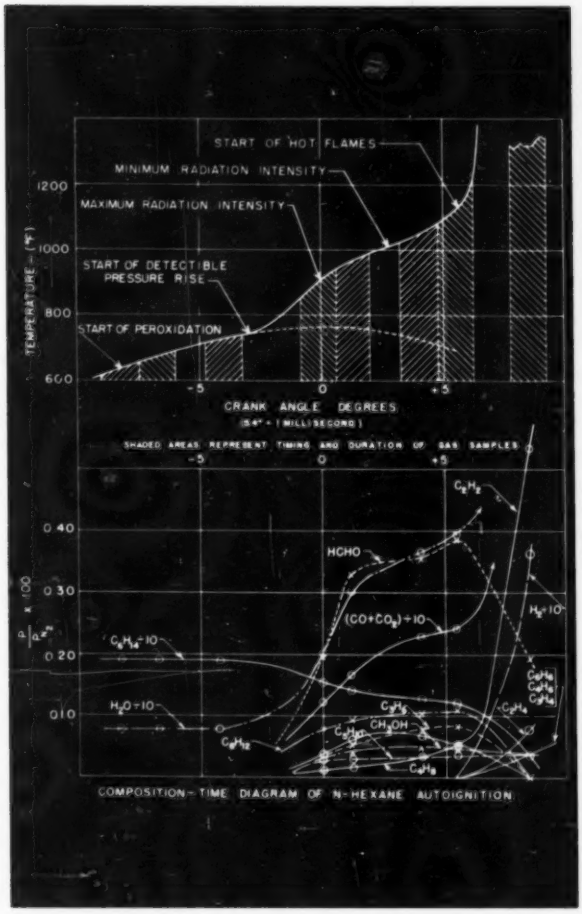
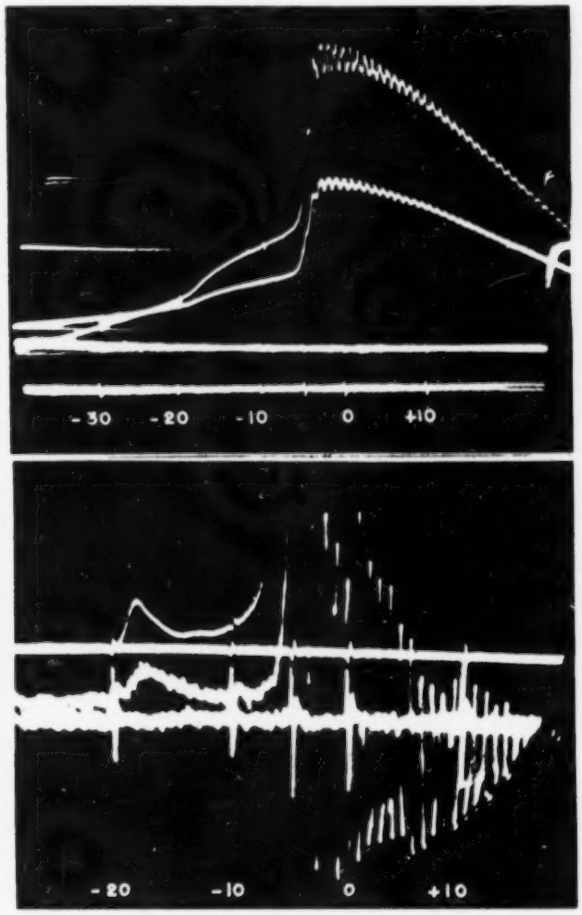


FIG. 1—Composition and temperature vs. time diagrams from data on n-hexane autoignition



TYPICAL OSCILLOGRAMS obtained in studies of autoignition in a lean n-heptane mixture

Acetylene a Factor in Autoignition

RESEARCH on engine combustion at the National Bureau of Standards has been providing considerable information of value on the chemical processes which take place within the cylinders of an automotive engine during the combustion cycle.

Among results and observations of interest were the following:

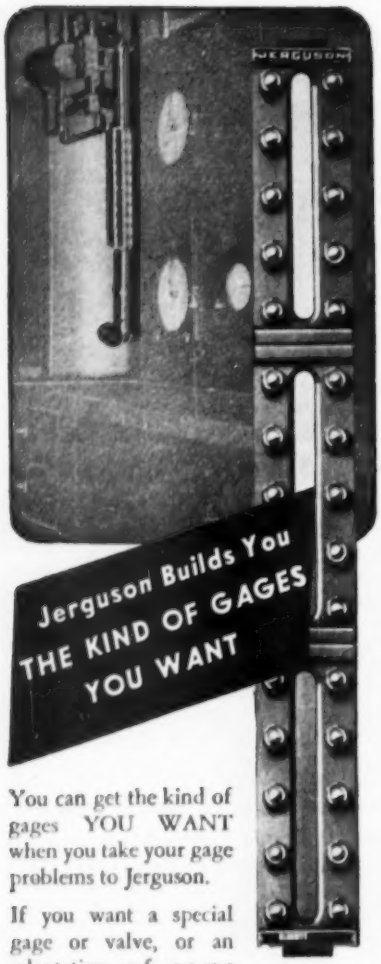
1—Acetylene appears to be an important intermediate in the hot-flame combustion of hydrocarbons. Work is now being carried on at the Bureau to determine the part played by acetylene in the earlier stages of combustion.

2—There is also considerable evidence, both from the NBS studies and from those in other laboratories, that acetylene may be the essential intermediate in carbon formation in burning mixtures. Carbon is readily formed in knocking combustion in engines, even with lean mixtures, and this may indicate that the formation of carbon from the acetylene present is a faster reaction than the direct oxidation of acetylene under these conditions.

By use of a very fast acting valve developed previously by NBS, it has been possible to take samples of the rapidly changing combustion gas over extremely short intervals. Analysis of these samples has yielded detailed knowledge of the proportions of reactants and products present at various stages of the cycle.

As the compression ratios of modern gasoline engines are continually raised, increasing difficulty is being caused by knock and preignition. The rapidly expanding use of Diesel engines has also emphasized problems of cold starting and engine roughness and smoking under heavy-load operation.

All these difficulties are associated with the combustion phenomenon known as *autoignition*, which occurs when a fuel-air mixture is heated by compression until it ignites spontaneously without spark. Fuel injected into the hot air in a Diesel cylinder



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ignites by this process, while knock in a gasoline engine is caused by explosive autoignition of the last, unburned portion of the fuel-air mixture to be traversed by the normal flame from the spark plug.

An extensive investigation of autoignition has been conducted in the NBS engine fuels laboratory by W. J. Levedahl and C. R. Yokley. Their apparatus includes a special, single-cylinder engine of variable compression ratio in which a wide range of operating conditions may be simulated.

The engine has been modified to permit the compression-ignition of a single homogeneous premixed charge of fuel and air in the absence of burned residual gases, cylinder hot spots, and lubricating oil. Pressure, rate of change of pressure, and light emission are oscillographically recorded as functions of crank angle or time. At any preselected time during the course of the reaction, the special sampling valve can be used to remove a sample from the reacting mixture during an interval of about 0.2 to 0.3 millisecond. Use of this valve enables the reaction to be followed by mass spectrometer.

Experiments have been carried out in the single-cylinder engine on a number of hydrocarbon fuels of various chemical structures. In general, it has been found that the autoignition of a paraffinic hydrocarbon occurs in a series of steps.

The first detectable reaction is the formation of peroxides at a temperature between 600° and 800° F. At a somewhat higher temperature, after peroxide concentration has become appreciable, a blue luminescence called the *cool flame* appears, accompanied by a substantial increase in temperature and pressure.

When the temperature has risen to about 1100° F, the rate of reaction suddenly increases at a rapid rate as the *hot flame* begins. The accompanying violent pressure rise initiates a pressure wave which is reflected back and forth across the combustion space, causing audible knock.

Investigation of many pure hydrocarbons, isooctane-*n*-heptane blends, and oxygen-containing compounds has shown that as octane number and resistance to autoignition increase, the temperatures at which peroxides and cool flames are first detected also increase while the amount of heat released during the cool flame decreases.

Over a wide range of fuel-air ratios, however, the temperatures at which hot flames first appear lie in the same temperature range—1100° F ±50°—for all aliphatic compounds studied. Because the octane numbers and autoignition resistances of the fuels investigated vary widely, these properties are thought to be functions of the extent of "self-heating" in the early stages of the reaction.

According to this view of the overall process, a very high-octane fuel must be heated by compression alone to nearly 1100° F before hot flames begin, whereas a low-octane fuel may contribute several hundred degrees of the required temperature rise by its own early reactions. Thus, the ease with which low-octane fuel autoignites is probably due to the large contribution of the cool-flame reactions in raising the mixture temperature to the necessary 1100° F.

The fact that the hot-flame stage of combustion begins at very nearly the same temperature for all fuels may indicate that this stage takes place as the result of the production of a single essential intermediate compound during the earlier stages of reaction. Or perhaps the reactions which occur are common to all the fuels studied.

Typical oscillograms obtained by NBS in studies of autoignition in a lean, n-heptane mixture are shown in the accompanying illustration. The two traces in the upper view are pressure-vs.-crank angle (or pressure-vs.-time) curves, with different amplification, for a single compression-ignition cycle.

In the lower view, the bottom curve shows rate of pressure rise, while the other curve shows radiation intensity. The cool flame begins at about 19° before top center: the hot flame starts at about 6° before top center, and is followed by violent knock vibrations. Crank angle of 5.4° is equivalent to one millisecond.

While *n*-hexane was being used as a fuel in the variable-compression engine, eight samples of the combustion gas were removed and analyzed in the mass spectrometer. Mixture composition was then plotted as a function of time during autoignition.

When a lean mixture was used, no large change in chemical composition occurred between the start of peroxidation and the beginning of intense cool flames. During the cool flame, however, the hexane decomposed into several olefins, acetylene, formaldehyde, carbon monoxide, carbon dioxide and water.

By the time the hot flame began, only about one-third of the hexane had decomposed, and this small amount of fuel had undergone sufficient oxidative degradation to cause

 (To obtain more data on advertised products see page 1936)

a temperature rise of about 450° F. In the early part of the hot flame most of the original fuel and fragments, including formaldehyde, were decomposed, while hydrogen and acetylene were formed in large quantities along with small amounts of diolefins and benzene.

Composition-time and temperature-time diagrams on n-hexane autoignition are shown in Fig. 1. In the lower diagram, the concentration of each component as determined in the mass spectrometer is shown in terms of its partial pressure referred to the partial pressure of nitrogen in the mixture.

Shaded areas in the upper curve represent timing and duration of gas samples. Samples were taken over the period from the start of peroxidation until the hot flame was well under way. The dotted line in the upper curve represents the temperature-time relationship for a nonreactive mixture in which autoignition would not take place.

Other sample analyses made with a series of branched and cyclic paraffins show that these fuels all produce olefins, carbon oxides, and water during the early reactions. The lower-octane fuels give larger quantities of these products, and, in addition, produce formaldehyde and acetylene during the cool flame.

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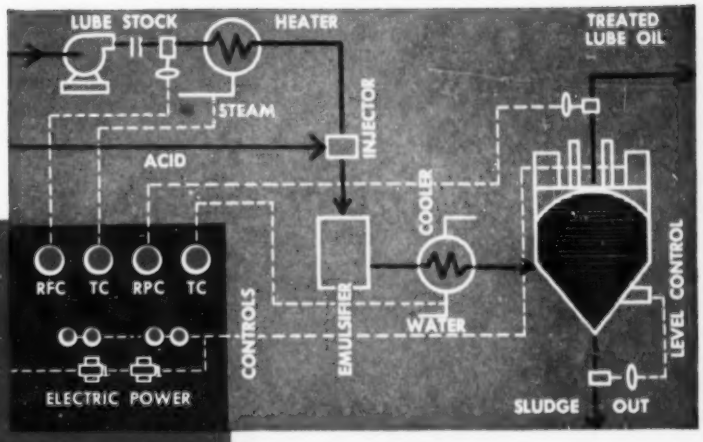

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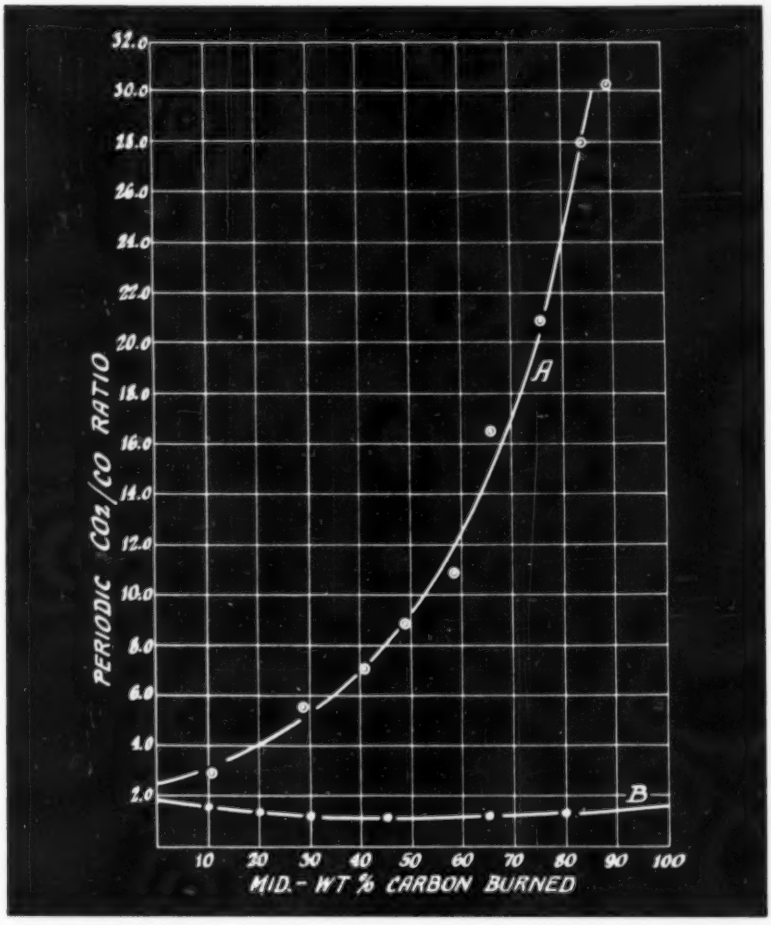
By Peter J. Gaylor, Patent Attorney, Newark, N. J.



Chromic Acid Used in Catalysts Overcomes Regeneration Afterburn

UNDER ordinary conditions, using ordinary catalysts, cracking usually is terminated after a 5-15 min. conversion period, due to deposition of a carbonaceous deposit which reduces catalytic activity. In the regeneration, large amounts of heat are released, so that precautions must be taken to prevent excessively high temperatures which may permanently damage the catalyst.

In the Socony-Vacuum Oil Co. Patent 2,647,860, it is pointed out that the regenerator is usually the limiting factor on the operation, capable of becoming a "bottleneck." In the processes using a compact moving bed (as in the TCC process), synthetic catalysts have given a great deal of trouble due to the resultant tendency of the regeneration fume to "afterburn" in the flues, resulting in a low ratio of CO_2/CO in the regeneration gases.

There is some evidence that slow combustion of the CO in fume from regeneration of synthetic catalyst results in an uncontrolled rise in temperature within the flues until ignition temperatures are reached. Actual propagation of flame appears to take place with serious damage to structural elements, and evidence has been found that the flame may be propagated back to the regeneration zone with resultant damage to the catalyst. This tendency of regeneration fume to afterburn in TCC kilns is restricted to that from burning of approximately the first 40% of the coke.

Other cracking catalysts, such as clay catalysts, are susceptible to sulfur poisoning and to deterioration from exposure to very high temperatures often encountered in the regeneration step. Frequent renewal also is necessary.

Static-bed type catalytic cracking, such as the Houdry process, does not appear to encounter the afterburning problem which presents definite limitation on the capacity of the equipment.

The patent discloses that this afterburning difficulty can be overcome by addition of 0.01—1.0% by weight of chromic acid incorporated in the catalyst when such catalyst is tempered by heating to at least 1100° F. in a relatively dry atmosphere. The amount of chromic oxide must be sufficient to raise the CO_2/CO ratio to values at which afterburning will not occur but, due to the fact that larger amounts of chromic oxide (above 1%) adversely affect the cracking reaction (by excessive coke formation), the amount of this component must be kept at levels which will not have an adverse affect on cracking yields.

The silica-alumina composite preferably contains 5-13% by weight of alumina, preferably prepared by coprecipitation from an aqueous solution of pH of around 8.5. The dry weight of chromium oxide preferably is about 0.05-0.35%, and the tempering of the catalyst is done at 1150°-1250° F. for activation. For best results, the catalyst should be retempered by heating to over 1100° F. during each cycle (say at 1300° F.).

Afterburning is not normally encountered in TCC kilns beyond the point when the first 40% of the coke is burned off. A peculiarity of these catalysts is the shape of the curve representing the variation in the CO_2/CO ratio with percentage of coke removed by burning. This relationship is shown in the graph in which Curve A represents the characteristics of a catalyst prepared from a hydrogel containing 92.9% SiO_2, 7% Al_2O_3 and 0.15% Cr_2O_3, while Curve B represents the behavior of catalysts not promoted with chromium oxide. The "Mid-Weight Percent Carbon Burned" is the amount of carbon removed by burning at the midpoint in any given time interval, and the CO_2/CO ratio is taken on the regeneration fume determined periodically over the specified time intervals.

Alkylene Polymers Act As Lube Dilatant Thickener

WITH the recent introduction of friction drive torque converters, there has been need for a dilatant lubricating fluid, i.e., one which thickens when subjected to shear and then immediately regains its normal fluidity when the shearing force is removed. In its U. S. Patent 2,652,368, Shell Development Co. discloses certain polymers of alkylene sulfones which have a particularly unique modified dilatancy in mineral oils making them particularly useful for this purpose.

The preferred material is a copolymer of sulfur dioxide with alpha-olefinic hydrocarbons having 7-24 carbon atoms. The olefins are derived by cracking paraffin wax, and the copolymer is produced by adding an excess of sulfur dioxide at a reflux temperature of —10° C. in presence of a catalyst such as peroxides or nitrates. Yields of 79-94% of polymer are obtained, having molecular weights ranging between 5000-100,000.

Such copolymers also possess V.I. improving properties as well as extreme pressure characteristics approximately 30% greater in maximum seizure load ratings than unmodified lubricating oils. About 1% by weight of a polymeric octadecene sulfone raised the V.I. of a mineral oil from 53 to 135.

It is pointed out that one of the limiting features of friction gears up to the present time has been the unsatisfactory performance of lubricants or fluids used with them for their lubrication and prevention of wear. In the act of lubricating or preventing wear, a film of oil between the friction gear surfaces usually results in increased slippage between the contact points of the surfaces of the engaging gears. Hence, the dilatant properties of these compositions are expected to find ready application in the lubrication of friction gears. When force is applied to the gears lubricated, the gelling action which results materially reduces the slippage to which ordinary lubricants are subjected.

Additive Reduces Gum Deposit, Valve Sticking

IT IS well known that, when present in gasoline, gum forms a hard, resinous deposit in the carburetor, the intake manifold and on the valves of internal combustion engines, particularly on the intake valves and valve parts. A Standard Oil Development Co. Patent (2,066,234) described an excellent oil additive to be added to gasoline to reduce valve sticking and other troubles caused by such gum deposits. It specifies that the oil should have a Kauri-butanol (solvency) number of at least 15, preferably over 20, a 100° F. Saybolt viscosity of 70-450 sec., an A.P.I. gravity of 18-28, and a flash point of 270°-375° F. This points toward a naphthenic, Coastal oil and excludes paraffinic oils having a low Kauri-butanol number.

In its recently issued Patent 2,654,697, Socony-Vacuum Oil Co. claims to have found that the addition of small amounts of a certain hydrocarbon fraction having no Kauri-butanol number, to a gasoline, decreases the formation of hard gum deposits in an internal combustion engine in which it is used. When a small amount of a petrolatum stock is added to a gasoline containing gum, valve sticking is claimed to be eliminated and excessive hard gum deposits reduced.

The additive is a petrolatum stock which is insoluble in the Kauri-butanol solution at 75°-80° F. and is preferably of Mid-Continent source, having the following properties:

A. P. I. gravity	About 30-35
Flash point	About 440° F
Viscosity, SSU at 210°F	95-125
Melting point, °F	115-135
Penetration, ASTM cone at 77°F	60-110

Ordinarily, the amount used in the gasoline is 0.15-0.25% by volume.

Patents Issued in October

The following classified listing gives the patent number, patentee, or assignee and a brief description of all patents believed to be of interest to the petroleum processing industries, as contained in the Official Gazette of the U. S. Patent Office for October 6, 13, 20 and 27, 1953, Vol. 674, Nos. 1-4.

PROCESSES

Refining

2,654,482 (Fram Corp.) Filter for removing ice crystals from hydrocarbon liquids and the like.
2,654,692 (Texaco Development Corp.) Solvent dewaxing.
2,654,693 (Shell Development Co.) Dewaxing mineral oil with MEK and propane as solvents.
2,654,696 (Sun Oil Co.) Treatment of lubricating oil by catalytic hydropenation for improving color.
2,654,706 (Peter J. Gaylor) Electrolytic regeneration of spent caustic. (covers ADA process)
2,654,714 (Visco Products Co.) Process of breaking petroleum emulsions and oxyalkylene compositions therefor.
2,654,792 (Phillips Petroleum Co.) Furfural gas-oil extraction process.
2,655,136 (Universal Oil Products Co.) Heating of fluids.
2,655,462 (M. W. Kellogg Co.) Recovery of phenol from extracts.
2,655,463 (Universal Oil Products Co.) Desulfurization of hydrocarbons with HF and fluorohydrocarbon.
2,655,467 (American Cyanamid Co.) Process for separating predominantly aromatic hydrocarbons from predominantly saturated hydrocarbons by extractive distillation, using molten phthalic anhydride.
2,655,468 (Standard Oil Development Co.) Recovering solvent from process steam.
2,656,010 (Phillips Petroleum Co.) Removal of nitrogen from natural gas, using granular adsorbent.
2,656,302 (Anglo-Iranian Oil Co. Ltd.) Hydrocatalytic desulfurization of petroleum hydrocarbons.
2,656,310 (California Research Corp.) Fractionation of alkyl aryl hydrocarbons.
2,656,342 (Standard Oil Development Co.) Hydrocarbon segregation utilizing urea and a nitrile.
2,656,380 (California Research Corp.) Production of diesel fuel oils and naphthenic acid soaps.
2,656,941 (Phillips Petroleum Co.) Pebble feeder.
2,657,175 (Standard Oil Development Co.) Desulfurization of petroleum residua by catalytic hydrogenation in presence of BF_3.

Catalysts

2,656,321 (Standard Oil Development Co.) Method for making alumina hydrosols.
2,656,322 (Phillips Petroleum Co.) Catalyst and method of preparing same (Ca, Cd, Zn or Cu coated with acid material).
2,656,323 (Universal Oil Products Co.) Manufacture of phosphoric acid-group IV metal oxide containing catalyst.
2,657,184 (American Cyanamid Co.) Alumina gel-containing catalysts.

Conversions

2,654,661-5 (Pittsburgh Consolidation Coal Co.) Gasification of carbonaceous solid fuels.
2,654,694 (Universal Oil Products Co.) Non-regenerative catalytic reforming process.
2,654,695 (Gulf Research & Development Co.) Process for preparing liquid hydrocarbon fuel from coal.
2,654,699 (Pittsburgh Consolidation Coal Co.) Method of discharging solids and gases from a fluidized bed.
2,655,273 (Phillips Petroleum Co.) Method and apparatus for evenly distributing solid contact material.
2,655,411 (Standard Oil Development Co.) Method and apparatus handling fluidizable finely divided solid materials.
2,655,437 (Hydrocarbon Research, Inc.) Fluidized solids reactor.
2,655,464-5 (Standard Oil Development Co.) Residuum coking and cracking, using fluidized bed.
2,655,466 (Standard Oil Development Co.) Process for shutting-down catalytic apparatus employed for the conversion of hydrocarbons.
2,655,470 (John W. Clark) Apparatus for treating carbonaceous material.
2,655,474 (Standard Oil Development Co.) Photochemical production of olefinic hydrocarbons from paraffins.
2,655,484 (Phillips Petroleum Co.) Refortification af aluminum halide-hydrocarbon complex catalyst.
2,656,242 (Standard Oil Development Co.) Apparatus and process for handling fluidized solids.
2,656,258 (Standard Oil Development Co.) Reaction furnace for contacting a gas and fluidized solids.
2,656,304 (Standard Oil Development Co.) Continuous fluid hydroforming of naphtha high in naphthenes.
2,656,305 (Tide Water Associated Oil Co.) Cracking with mixed catalysts.
2,656,306 (Socony-Vacuum Oil Co.) Method and apparatus for conducting moving contact material hydrocarbon conversion processes.
2,656,307 (Phillips Petroleum Co.) Conversion of ethane, heavy gas oil, fuel oil, etc. in several steps.
2,656,308 (Institute of Gas Technology) Distillation of oil-shale.
2,656,309 (Walter T. Brown) Process of coking a mixture of a carbonaceous material and a high boiling bituminous pitch.
2,656,398 (Phillips Petroleum Co.) Polymerization of ethylene with palladium oxide containing catalyst.
2,657,121 (Lummus Co.) Catalytic reactor.
2,657,245 (Sharples Chemicals, Inc.) Process for the manufacture of tetramethylethylene from propylene using BF_3.
2,657,246 (Standard Oil Development Co.) Selective polymerization of isobutylene with Al Cl_3.

Hydrocarbon Synthesis

2,654,659 (Phillips Petroleum Co.) Distribution for inlet synthesis gas.
2,655,442 (Phillips Petroleum Co.) Process and

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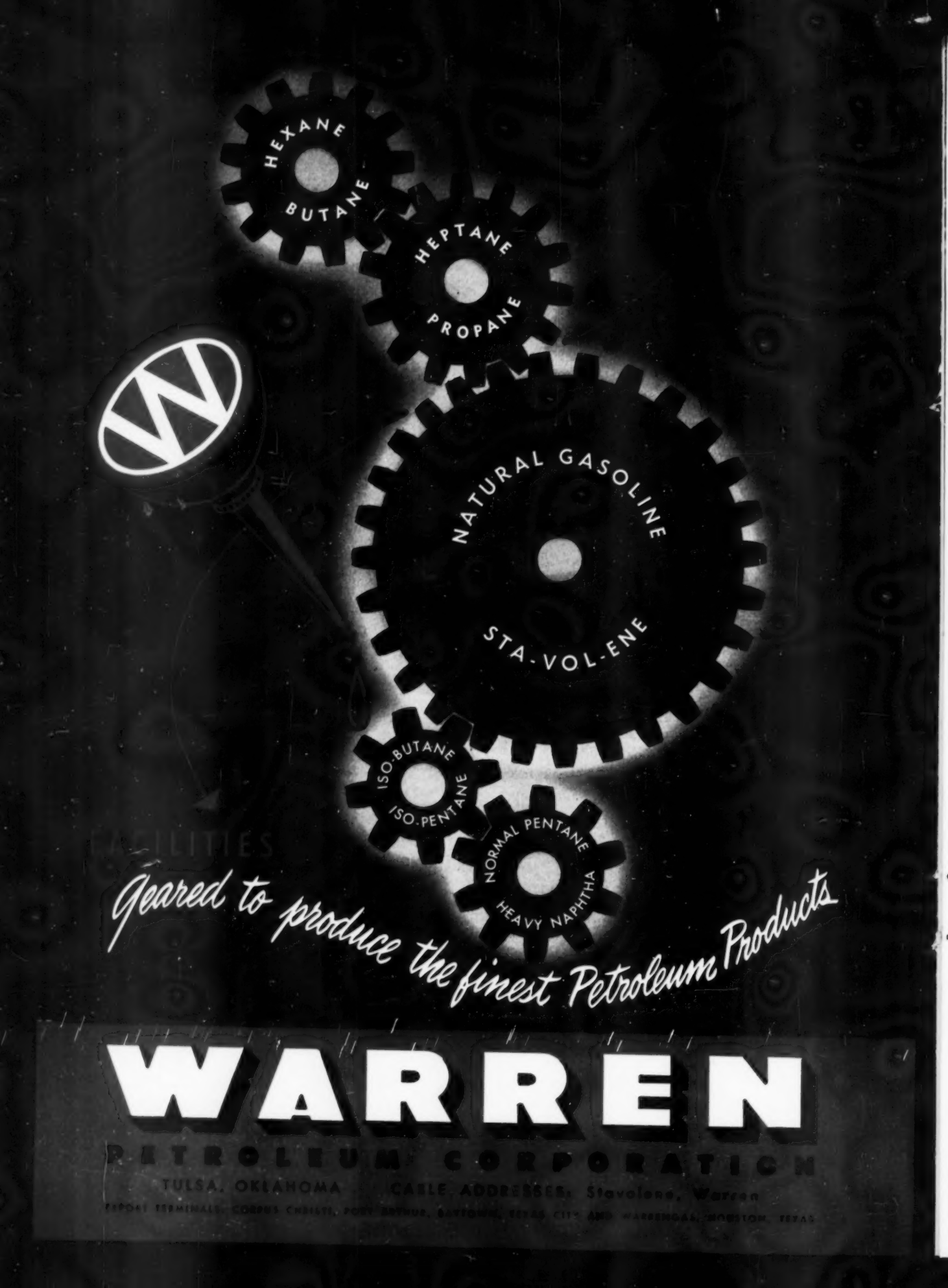
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apparatus for the manufacture of synthesis gas.
2,655,443 (The Texas Co.) Synthesis gas generation.

PRODUCTS

Chemicals

2,654,658 (M. W. Kellogg Co.) Apparatus for nitration of organic compounds.
2,654,679 (Shell Development Co.) Stabilized reaction products of rubbery polymers with inorganic acidifying compounds.
2,654,680 (Shell Development Co.) Method for increasing stability of rubbery polymer reaction products and resulting compositions.
2,654,722 (Standard Oil Development Co.) Stabilized solid rubber organic compositions containing acyl-p-amino-phenols.
2,654,727 (Socony-Vacuum Oil Co., Inc.) Esters of thiophene-modified maleic anhydride-styrene copolymers.
2,654,732 (Universal Oil Products Co.) Luminescent resins from aryl-substituted alkyl haldies and alkenyl ethers of a polyhydroxy organic compound.
2,654,733 (Shell Development Co.) Organic ammonium hydrosulfide-hydrogen sulfide reaction products and method for producing the same.
2,654,768 (M. W. Kellogg Co.) Production of fatty acid concentrates.
2,654,788 (M. W. Kellogg Co.) Nitration of organic compounds.
2,654,789 (Ethyl Corp.) New chlorofluoro derivatives of cyclo-hexane and method of making same.
2,655,430 (Shell Development Co.) Method of making calcium sulfate from refinery waste acid.
2,655,469 (Pure Oil Co.) Method of removing active sulfur from sulfurized organic compounds.
2,655,482-3 (Standard Oil Development Co.) Recovery of useful product (sodium sulfur salts) from spent doctor.
2,655,492 (Standard Oil Development Co.) Polyethylene compositions containing styrene-isobutylene copolymers.
2,655,495 (Polymer Corp. Ltd.) Arsenite catalyst activator for butadiene polymerization.
2,655,525 (Standard Oil Development Co.) Sulfated alcohol detergents from reaction product of primary monohydric alcohols with ethylene.
2,655,530 (Atlantic Refining Co.) Method of purifying alkylated aryl sulfonate detergents.
2,655,534 (E. I. duPont deNemours & Co.) Preparation of N-aromatic-N'-aliphatic hydrocarbon ureas.
2,655,544 (Standard Oil Development Co.) Alkylation of phenols with polypropylene.
2,655,546 (Gulf Research & Development Co.) Preparation of tertiary alkyl aryl ethers.
2,656,247 (Phillips Petroleum Co.) Ammonium sulfate and calcium oxide manufacture.
2,656,248 (Phillips Petroleum Co.) Ammonium sulfate production.
2,656,251 (American Cyanimid Co.) Process for the manufacture of HCN from ammonia, hydrocarbon and oxygen by catalyzed combustion.
2,656,255 (M. W. Kellogg Co.) Manufacture of hydrogen.
2,656,303 (Pan American Refining Corp.) Refining clay polymer hydrocarbon resins with HF.
2,656,311-2 (Gulf Research & Development Co.) Stabilization of phenol alkylates by inhibiting dealkylation with alkali metal phenate.
2,656,313 (Ethyl Corp.) Photochemical production of benzene hexachloride.
2,656,335 (Universal Oil Products Co.) Resin and process for its manufacture.
2,656,340 (Standard Oil Development Co.) Aromatic-alkene copolymers of less than 5% aromatic content.
2,656,375 (Tide Water Associated Oil Co.) Amino bicyclohexyl-alkyl acid phosphate reaction product.
2,656,377 (California Research Corp.) Process for the separation of isophthalic and terephthalic diesters.
2,656,392 (Phillips Petroleum Co.) Process for the manufacture of dialkyl sulfides from mercaptans by copper-oxidation in aromatic hydrocarbon solution.
2,656,393 (Union Oil Co. of Calif.) Reaction products of hydrogen sulfide and salts of aci-nitro-hydrocarbons.
2,656,397 (Shell Development Co.) Isomerization in presence of ethyl benzene and separation of xylenes.
2,657,119 (Texas Gulf Sulphur Co.) Conversion of sulfur dioxide to sulfur with hydroquinones.
2,657,185 (Standard Oil Development Co.) Blends of elastomers with modified phenolic resins.
2,657,190 (Standard Oil Development Co.) Blends of polybutadiene and butadiene-acrylonitrile copolymer.
2,657,194 (California Research Corp.) Linear polyesters from stilbene dicarboxylic acids.
2,657,195 (California Research Corp.) Linear polymers from stilbene dicarboxylic acid.
2,657,238 (Shell Development Co.) Catalyzed reactions between hydrogen sulfide or dimercaptans and dialkenyl ethers or polyalkenyl amines.
2,657,243 (Standard Oil Development Co.) Isopropyl alcohol process.

Fuels

2,654,660 (Gulf Research & Development Co.) Stable fuel oil compositions comprising straight run and cracked mixture with metal monoamide salt as sludge inhibitor.
2,654,697 (Socony-Vacuum Oil Co.) Motor fuel containing petrolatum to prevent valve sticking.
2,654,769 (Socony-Vacuum Oil Co.) Preparation of indium acetylacetonate.
2,655,440 (California Research Corp.) Diesel fuel oil containing cetane improvement additive.
2,655,786 (Phillips Petroleum Co.) Method of operating jet engines with fuel reforming (to produce CO and hydrogen).
2,656,259-60 (Gulf Oil Corp.) Stabilized hydrocarbon fuel oils.
2,656,301 (Phillips Petroleum Co.) Process for making high octane gasoline (using acetonitrile extraction).

Lubricants

2,654,708-9 (Gulf Research & Development Co.) Compounded hydrocarbon oils and detergent addition agents therefor, comprising salt of monoamide of dicarboxylic acid.
2,654,710 (California Research Corp.) Polysiloxane-aluminum soap greases.
2,654,711 (Standard Oil Development Co.) Monocyclic terpene-sulfur-phosphorus sulfide reaction product and lubricating oil containing the same.
2,654,712 (Standard Oil Development Co.) Sulfurized monocyclic terpenes and oil compositions containing them.
2,655,476 (Standard Oil Co. Ohio) Thickened lu-

Yes, dehydration of vapor and liquid feed stocks in petrochemical processing is best accomplished with superior drying efficiency by use of FLORITE DESICCANT.

Most economical of the granular drying agents, Florite has a longer service life, gives a low dew point depression, and aggressively resists "poisoning effects" which permanently destroy adsorption qualities.

Let us prove that Florite is best suited for your desiccant requirements, too. Your inquiry will bring prompt response.

FLORIDIN COMPANY
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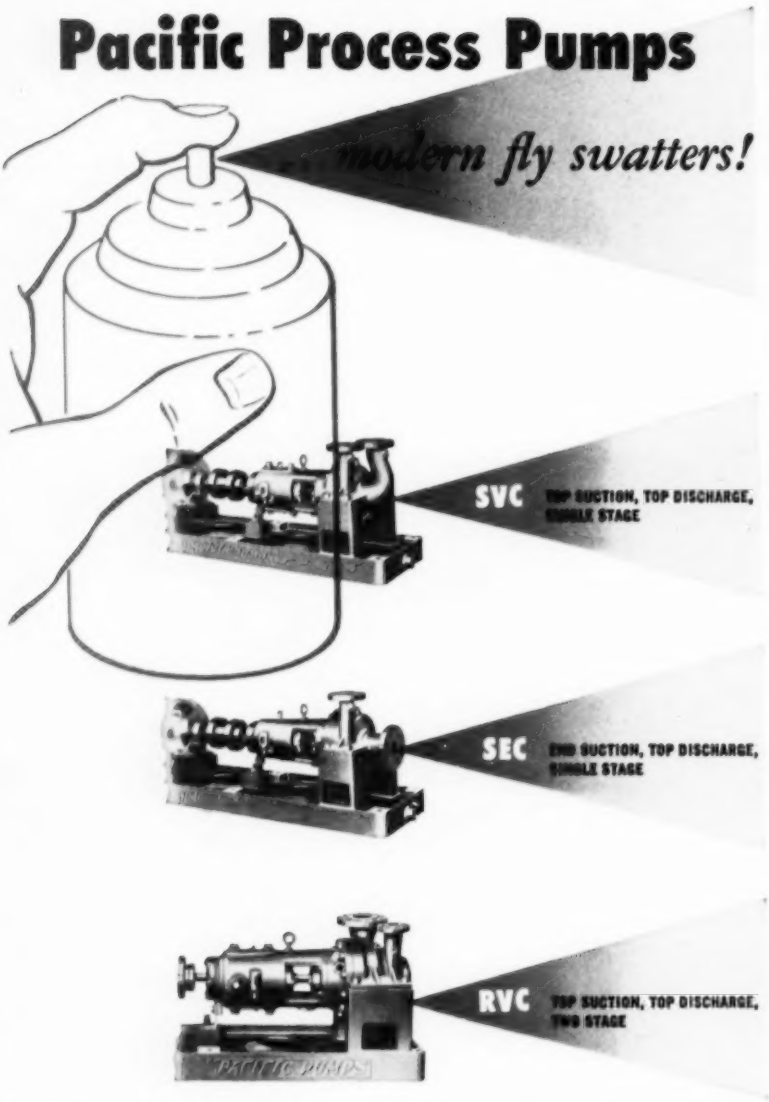
(To obtain more data on advertised products see page 1936)

Pacific Process Pumps



★ Custom fabricated from properly chosen materials to perform their tough jobs, Pacific process pumps give a mighty assist in the production of insect sprays, detergents, antiseptics and a host of other products that safeguard health and give comfort to mankind . . . thus in a sense becoming "modern fly swatters." The widespread use of Pacific process pumps for heavy-duty assignments in the petro-chemical industry is conclusive proof of Pacific's ability to perform continuous service with sustained economy.

Pacific single-stage Types SVC and SEC handle liquids from sub-zero to 800°F., 15 to 1,600 gpm, 500 to 600 psig, discharge pressure, differential heads up to 600 feet, speeds to 4,000 rpm. Two-stage Type RVC pumps liquids from sub-zero to 850°F., 50 to 600 gpm, discharge pressure to 600 psig, differential heads to 825 feet, speeds to 3,600 rpm. For further details, write for Bulletins 101 and 108.

PACIFIC *Precision Built* PUMPS

Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA

Export Office: Chanin Bldg., 122 E. 42nd St., New York

Offices in All Principal Cities PP-12

Patents

bricants, using polyamine imidazoline.
2,655,477 (Standard Oil Co.—Ohio) Mineral lubricating oil containing a P-S anticorrosive agent and an antioxidant detergent agent (Ba derivative of P-S treated dioctadecylamine).
2,655,478 (The Texas Co.) Noncorrosive soluble oil containing active sulfur, containing alkylene polyamine.
2,655,479 (Standard Oil Development Co.) Polyester pour depressants.
2,655,549 (Standard Oil Development Co.) Process for the preparation of pour depressing lubricating oil additives (polymerized vinyl aromatic).
2,656,177 (Sun Oil Co.) Engine oil consumption apparatus.
2,656,315 (The Texas Co.) Lubricating greases thickened with calcium silicate.
2,656,316 (Union Oil Co. of Calif.) Lubricating oils containing metal salts of a condensation product of a substituted phenol and a vinyl compound.

EQUIPMENT

Instruments

2,654,250 (Edward R. Harrington) Liquid sampling apparatus.
2,654,387 (American Cyanamid Co.) Apparatus for controlling flow of gases.
2,655,041 (Union Carbide & Carbon Corp.) Flowmeter.
2,655,044 (California Institute Research Foundation) High vacuum gage.
2,655,045 (Minneapolis-Honeywell Regulator Co.) Mercury manometer.
2,655,176 (Minneapolis-Honeywell Regulator Co.) Control panel.
2,655,351 (Aktiebolaget Separator) Temperature control for heat exchangers.
2,655,933 (Thomas A. Edison, Inc.) Liquid controlling system for tank filling.
2,656,508 (Wallace H. Coulter) Apparatus for counting particles suspended in fluid.
2,656,611 (Union Machine Co.) Liquid level gage.
2,656,724 (Elmer H. Cox and Harry B. Copeland) Automatic apparatus for liquid sampling.
2,656,725 (Standard Oil Development Co.) Automatic sampler for liquid hydrocarbon streams.
2,656,848 (Thompson Products, Inc.) Duplex flow control apparatus.

Pumps & Compressors

2,654,325 (Borg-Warner Corp.) Gear-type pump.
2,654,326 (Milton Roy Co.) Constant delivery pump.
2,655,868 (Fairbanks, Morse & Co.) Bladeless pump impeller.
2,655,869 (Daniel Murphy) Rotary pump.
2,656,096 (Societe Rateau) Centrifugal pump and compressor.
2,656,796 (Lawrence M. Garner and Edward S. McConnohie) Unidirectional rotary variable delivery fluid pump.
2,656,971 (Emil A. Mader and John Spargo) Combined fluid impeller and self-sealing closure.

Valves & Fittings

2,654,394 (Powers Regulator Co.) Packless valve.
2,654,396 (Charles K. Kuthsing) Discharge valve for container for gases under high pressure.
2,654,559 (Imperial Brass Mfg. Co.) Diaphragm valve.
2,654,562 (Foster Engineering Co.) Throttle valve.
2,654,563 (Gray Tool Co.) Valve with removable seat.
2,654,564 (Manning, Maxwell & Moore, Inc.) Shuttle valve.
2,654,975 (Denison Engineering Co.) Pressure reducing valve.
2,655,173 (Parker Appliance Co.) Piston-actuated sleeve type relief valve.
2,655,316 (Miles L. Edwards) Mixing valve.
2,655,930 (Electraulic Presses Ltd.) Unloading and relief valve.
2,655,935 (Robert B. Kinzbach) Pressure relief valve assembly.
2,655,936 (Westinghouse Electric Corp.) Valve assembly.

How to Obtain Patents

Readers may obtain copies of any U. S. Patent from the Patent Office at 25¢ each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

UNITED REFINING COMPANY marks its

50th Anniversary

...with a Blaw-Knox "Catforming" Plant

In line with its 50-year policy of using the latest refining techniques in the manufacture of premium quality products, United has commissioned Blaw-Knox Company, Chemical Plants Division, to design and construct a "Catformer" plant at their Warren, Pennsylvania refinery.

The Atlantic Refining Company "Catforming" process is an economical means for up-grading low grade naphthas to high octane gasoline at 95-100 per cent yield. The catalyst is selective and rugged; the yield-octane relationships are well established by pilot plant evaluation of numerous stocks; and commercial operations have confirmed basic design features.

Chemical Plants Division is licensed to offer Atlantic's "Catforming" process and would be pleased to discuss product yields and qualities, plant investment and operating costs with you. "Catforming" offers an economically attractive solution to your octane problem.

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CHEMICAL PLANTS DIVISION
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Moist, salty atmosphere makes the Gulf Coast of Texas the *Playground of Corrosion.* Here Refineries and Chemical Plants rely upon Insul-Mastic Coatings for protection against rust. From Brownsville to Lake Charles you will find tanks, towers, pipes, vessels and other equipment heavily sprayed with this *Superior* coating. Maintenance operations everywhere have been greatly reduced because INSUL-MASTIC's protection will last for many, many years.

Stopping moisture alone does not prevent corrosion here. Acid, alkali and other industrial vapors work hard to break down coatings and get at the metal beneath. That's why the very durable INSUL-MASTIC coatings are so extensively specified along the Gulf Coast. They are extremely resistant to chemicals as well as to moisture.

INSUL-MASTIC's record in *corrosion's playground* cannot be approached. There are many years and hundreds of jobs to prove its lasting protection. Specify INSUL-MASTIC to prevent corrosion.

Insul-Mastic's record also includes vaporsealing thermal insulation. There's no better way to keep your insulation dry.

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 (To obtain more data on advertised products see page 1936)

CHEMICAL PROCESS NEWS

PUBLISHED BY CHEMICAL PROCESS DIVISION, THE M. W. KELLOGG COMPANY DECEMBER 1953

NOTES ON

AMMONIA

The cost of a plant for the production of synthetic ammonia is greatly affected by the composition of the feed gas.

* * *

Conventionally, if natural gas is the feed it must undergo several preparatory steps to produce a suitable mixture for the ammonia synthesis. Reforming or partial combustion must be followed with CO shift and then absorption purification to remove CO_2 and unconverted CO. On the other hand, if hydrogen-rich gas is the charge the process requirements are greatly simplified. The feed is chilled to low temperature and subjected to liquid nitrogen washing to remove impurities. Ammonia synthesis is accomplished by the same method with either feed stock.

* * *

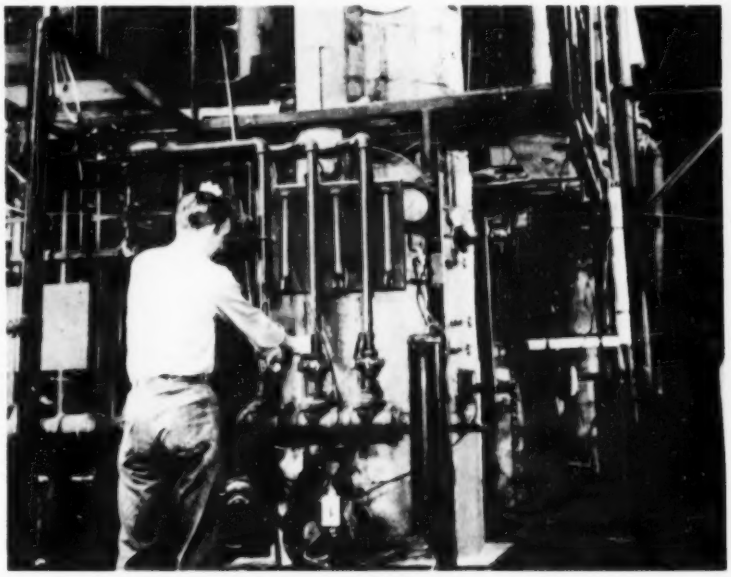
Since the largest single item of cost in the production of ammonia is the charge for plant depreciation, (about 20% greater than per-ton-direct-operating-cost in a natural gas feed plant) the extent of the equipment required to prepare synthesis gas has a major effect on total production cost.

* * *

Economic analyses of processes involving both feeds show that the payout time for plant utilizing hydrogen-rich gas is in the neighborhood of three years, and that employing natural gas is less than five years.

* * *

Thus there is a great economic incentive for anyone with hydrogen-rich gas or by-product hydrogen available to enter the fields of ammonia production.



Ethylene Pilot Plant Studies Disclose Flexibility of Unique Pyrolysis Method

In the pilot plant shown in the illustration Kellogg is currently carrying on extensive studies of the adaptability of its unique pyrolysis process to the production of high purity ethylene from feed stocks other than naphtha—the charge stock for which the process was originally developed.

The pilot plant runs have already proved that the method can be employed successfully on ethane, propane and heavier materials without production of the large amounts of coke normally encountered in conventional processes.

This low coke production had been predicted on the basis of commercial operating reports from an ethylene plant which Kellogg designed and erected in England for the pyrolysis of naphtha.

Whereas conventional pyrolysis furnaces usually average only a few weeks on stream before being shut down for coke removal, the English plant has remained in continuous operation for 12-month periods. During these times it was operated with sufficient severity to convert 55 to 60 wt.% of the naphtha to ethylene and other gaseous hydrocarbons.

The unique fractionation system of the English plant has also proved highly efficient as demonstrated by the fact that the plant produces 99.9% pure ethylene.

In addition to producing high quality products over extended periods, the plant has attained maximum economy of the heat required for pyrolysis. A novel design in the quenching system which follows the pyrolysis step, plus the use of low-level heat by the absorption refrigeration system, provide major savings through recovering most of the heat used in cracking.

Technician in Kellogg's Analytical Laboratories determines olefin yields from pyrolysis pilot plant run.

(SEE REVERSE SIDE)

CONTINUED FROM PRECEDING PAGE

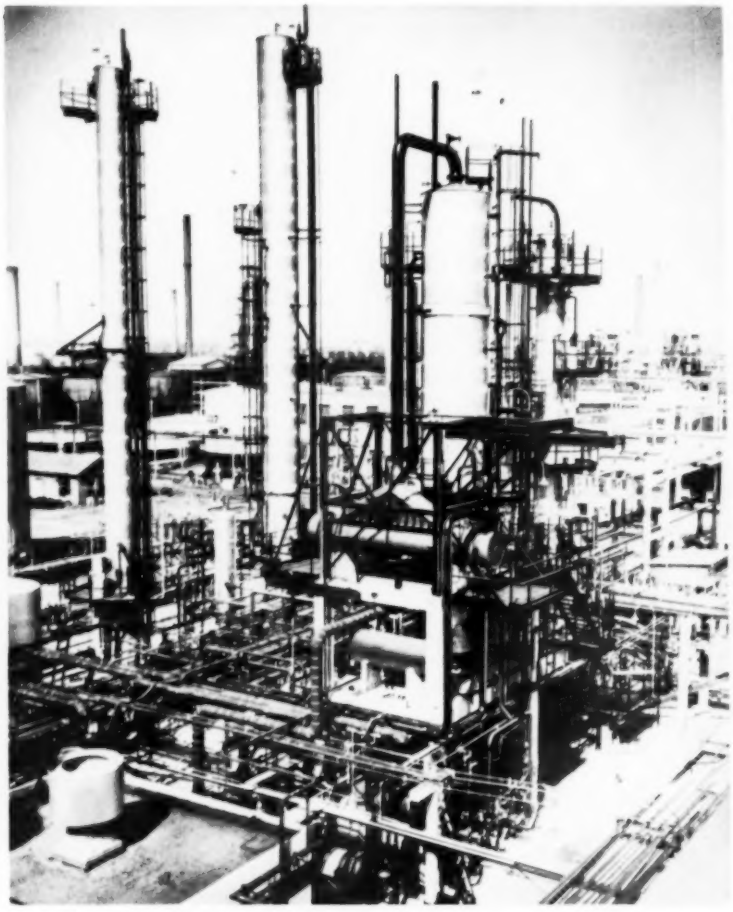
Work Well Underway On Fluid Phthalic Plant in England

Work is well underway on a Fluid phthalic anhydride plant now under construction in England. It is scheduled for completion by the Spring of 1954.

Several design improvements have been developed since the first such plant was built in the U. S. and they are being incorporated in the new plant.

Most important is the re-design of the condensing system which not only decreases capital investment but also improves operating conditions. It precludes, for example, any need for operators to come in direct contact with the phthalic or its fumes.

A second unit is also being built, this one on the Continent. Between the two they will produce about 50 million pounds of phthalic anhydride annually. The product in this process is produced by the oxidation of naphthalene in the presence of a fluidized solid catalyst.



NEW ALCOHOL PLANT . . . is well on the way toward completion in the Mid-West. Employing the basic OXO process, it will produce iso-octyl alcohol. This view was taken looking northeast over the east end of the control room to the main fractionating tower group. Shown in the background are alcohol, alcohol re-run and aldehyde columns.

Two New Process Bulletins Issued

"Make high quality urea with lower initial investment, decreased operating investment, operating costs . . ."

Bulletin describes advantages of new Montecatini "Ammonia-Saturated" Urea Process now licensed exclusively in the United States by The M. W. Kellogg Company.

"High yields, low operating cost through ammonia plants . . ."

Investments for ammonia plants employing either natural or hydrogen-rich gas are shown in convenient form, as are utilities and other operating costs.

For your copies write CHEMICAL PROCESS DIVISION, The M. W. Kellogg Company.

Typical Current Kellogg Chemical Plant Contracts in the fields of—

- ★ Ethylene
- ★ Polyethylene
- ★ Phenol-from-Cumene
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- ★ Methanol
- ★ Phthalic Anhydride
- ★ Iso-octyl Alcohol
- ★ Liquid Fuel and Chemicals Synthesis from Coal
- ★ Glyceride Purification
- ★ Nitric Acid
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For further information, technical data, etc., relating to chemical or petrochemical processing, write

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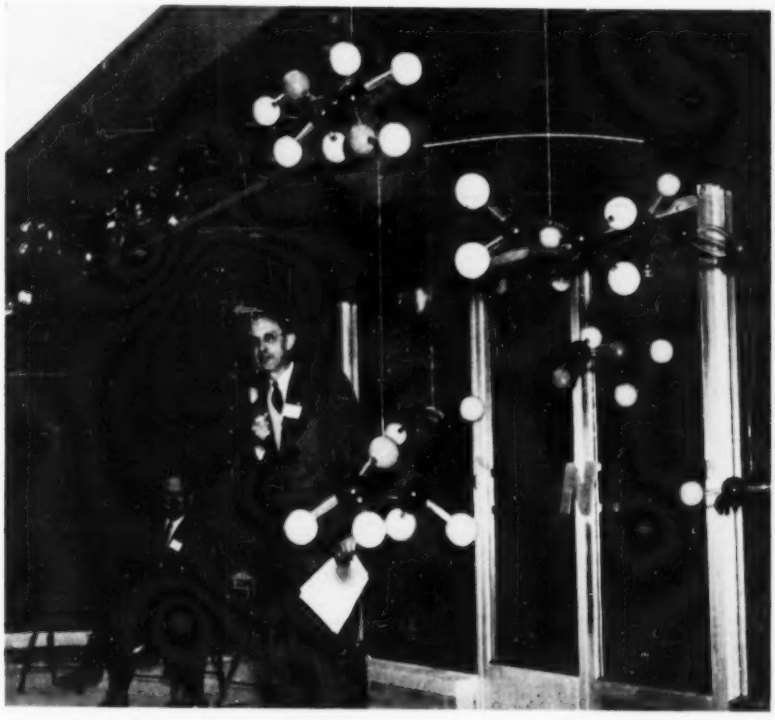


Molecular "Mobile" Features Lab Opening

F. O. Agel, director of development—organic, Allied Chemical & Dye Corp., Nitrogen Division, is shown making the dedicatory address at the opening of the division's new organic research laboratory and development center at Hopewell, Va., in October.

His address explained the molecular "Mobile" at right. The "Mobile", one of the newest art forms, is composed of various organic chemical molecules delicately suspended so as to be in almost constant movement. Each of the molecules represents an organic chemical product to be investigated in the laboratory, and in several instances, to be produced at the division's new organic chemicals plant under construction at Orange, Texas.

Visible in the left background is Dr. M. F. Fogler, divisional executive vice president, and, partially hidden, Dr. C. S. Fazel, vice president.

Bruce B. Farrington was given the National Lubricating Grease Institute's first annual award for the outstanding contribution to the lubricating grease industry at the association's annual dinner meeting in Chicago in October.

Mr. Farrington, administrative assistant to the manager of petroleum products research at California Research Corp., a Standard Oil Co. of Calif. subsidiary, was honored for his electron microscope investigations into the real structure of lubricating grease.

He is a chemistry graduate of the University of California, first joining Standard of Calif. in 1921. In subsequent years he carried out research on motor oil additives, detergent Diesel oils and petroleum specialties with that company. He is a member of the Grease Institute, as well as the American Chemical Society, American Society for Testing Materials and several other professional associations.

J. H. McClintock has been named chairman of a newly-formed committee to study losses of petroleum liquids by evaporation by President Frank M. Porter of the American Petroleum Institute. Mr. McClintock is with Esso Standard Oil Co., New York.

The group is to be known formally as the Committee on Evaporation Loss. Specific scope of its activities will be the "development of factors governing the evaporation loss of petroleum liquids for use in solution of operating problems."

At an organizational meeting, the new committee set up four operating sub-committees, with these chairmen: Method of Testing, **H. M. Hart,** Standard Oil Co. (Ind.); Correlations, **A. B. Stevens,** General Petroleum Co.; Test Program Development, **H. C. Packard,** Shell Oil Co.; Program and Publications, **W. L. Hoffman,** Socony-Vacuum Oil Co.

Ray J. Hull, senior research engineer for California Research Corp., received the first annual award for meritorious service to the California Natural Gasoline Association at that group's 28th annual fall meeting in Los Angeles in October.

The award, consisting of a plaque and gold watch, was presented by L. V. Cassaday, chairman of the award committee and president of Lomita Gasoline Co. In the future the presentation will be made annually to a member of CNGA who has not reached his 43rd birthday on Oct. 1 prior to the association's regular fall meeting. Purpose is to stimulate activity by younger members and recognition will be for either administrative or technical service.

Mr. Hull has been a member of CNGA since 1950, and has also been a director since that year. In addition to administrative duties, he has served as vice chairman of the technical committee, chairman of the fundamental analysis committee and CNGA representative at joint technical meetings with the Natural Gasoline Association of America. He has also authored several technical papers presented before CNGA.

Dr. Harold R. Snow has been named general manager of manufacturing of Pan American Refining Corp. Dr. Snow, a vice president of Pan Am Refining and Mexican Petroleum Corp. of Georgia, formerly was general manager of Pan Am's largest refinery at Texas City, Texas.

S. B. Schapiro, previously general superintendent, Texas City plant, is now manager of engineering, construction and maintenance for the firm.

Elmore S. Pettyjohn, vice president and director of the Institute of Gas Technology at Illinois Institute of Technology, has received a "distinguished alumnus" award from the University of Michigan's college of engineering.

Mr. Pettyjohn was given the honor

Critical Jobs Are Routine For Johnston Pumps!

HANDLING HIGH OCTANE GASOLINE, FOR EXAMPLE . . .

When the Burbank Air Terminal, near Los Angeles, modernized its aircraft fueling system, a Johnston Volatile Fluids Pump rated at 40 H.P., with a capacity of 800 G.P.M. against a 218 foot head, was selected for the job.

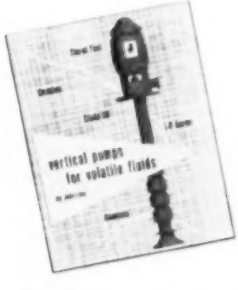
Here's why—

Bowls and impellers are submerged in the gasoline, thus eliminating the necessity of expensive and complicated priming devices such as flap valves, recirculation chambers and others.

Entrapment of air or vapor is no problem to a Johnston, because the discharge is vented back to the storage tank.

Because of its stable head-capacity characteristic and flat horsepower requirements, a Johnston insures better efficiency of operation over a wider range of dispensing capacity.

This is another example of the ability of Johnston equipment to handle all kinds of pumping jobs. For the kind of pump "know-how" that puts money in the bank, see your Johnston Dealer, or ask a factory representative to call. They're always glad to help.



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JOHNSTON
VERTICAL PUMPS

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in recognition of his "contributions to the development of the field of engineering." He received his undergraduate and post-graduate schooling at the University of Michigan, and subsequently taught there as an associate professor of chemical engineering.

Eugene J. Haug has joined the staff of the American Petroleum Institute as an engineer in the Division of Refining. His work will be concerned primarily with projects of the Committee on Refinery Equipment.

Mr. Haug

For the past two years, Mr. Haug has been in business for himself, designing specialty equipment for use in catalytic cracking operations. In 1934 he joined Chemical Construction Co., doing design work on acid-sludge disposal plants. Later he was associated with Gielow, Inc., Dekom Shipbuilding Corp., and Arthur G. McKee Co. in 1951, Mr. Haug joined Lummus Co. as project engineer where he worked on a variety of refinery design and construction problems, with emphasis on fluid catalytic cracking units.

He is a graduate in mechanical engineering from Villanova College.

R. A. Reinke, superintendent of the Continental Oil Black Co. at Westlake, La., has been promoted to technical coordinator of Continental Carbon Co., with headquarters in Amarillo, Texas. He will direct the company's Amarillo control and technical service laboratory and function as liaison officer between plant production and sales.

Mr. Reinke is a 1939 chemistry graduate of the University of Chicago.

Clifford L. Cook will be the superintendent of Quaker State Oil Refining Corp.'s new oil packaging plant to be constructed in Portland, Ore. The new facilities are expected to be in operation by April 1, 1954.

Mr. Cook, a 30-year Quaker State veteran, previously was stationed at the company's Oil City, Pa., refinery.

Dr. Judson S. Swearingen, a consultant to Southwest Research Institute, has established an annual $100 award for outstanding non-commercial scientific research achievement to be made to any full-time member of the Institute below the level of department chairman.

Mr. Swearingen formerly was active in the refining industry, and once was professor of chemical engineering at the University of Texas.

Dr. James F. Eversole has been named vice president in charge of research for Bakelite Co., a division of Union Carbide and Carbon Corp. Dr. Eversole started out with Union Carbide in another of its divisions, Carbide and Carbon Chemicals Co. as a research chemist in 1929. Until his present appointment he was manager of research administration for the parent company, coordinating research activities among all the firm's divisions.

Cecil W. Humphreys has been appointed vice president in charge of manufacturing for Shell Chemical Corp. Previously, he had been general manager and manager of development for the company's manufacturing department.

Mr. Humphreys

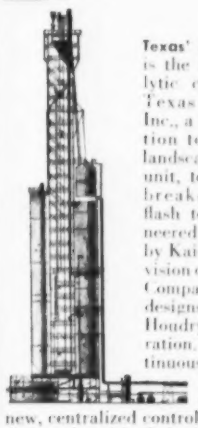
Mr. Humphreys graduated from College of the Pacific in 1927, and received his PhD. in chemistry and engineering from Stanford University in 1931. He joined Shell Chemical as a laboratory assistant at the Pittsburg, Calif., plant, later becoming chief chemist at the company's Martinez, Calif., plant. In 1941 he moved to Houston as manager of the chemical manufacturing facilities. He became manager of operations of Shell Chemical's manufacturing department in 1946.

Jack Anderson has been promoted to general foreman, process division at the Sugar Creek, Mo., refinery of Standard Oil Co. (Ind.). Mr. Anderson, a chemical engineering graduate of the University of Oklahoma, was formerly assistant general foreman, same division.

Foster Dee Snell, president of Foster D. Snell, Inc., consulting chemists, has been re-elected to a one-year term as president of the Association of Consulting Chemists and Chemical Engineers, Inc.

what's NEW in Engineering

An ingenious new alarm system which automatically sounds a warning when overloaded industrial equipment gets too hot, is said to be the answer to the problem of having to feel bearing cases and check thermometers scattered over a wide area. The moment a motor gets "too darn hot", a bulb lights up, and a central monitor gives out an audible alarm.



Texas' newest landmark is the Houdriflow catalytic cracking unit of Texas City Refining, Inc., a spectacular addition to the southwest landscape. The cracking unit, together with visbreaker and vacuum flash tower, were engineered and constructed by Kaiser Engineers Division of Henry J. Kaiser Company from the basic designs prepared by the Houdry Process Corporation. A new-type continuous bulk handling system for fresh catalyst and a new, centralized control system were also designed and built by Kaiser Engineers' process specialists.

To be published January 1, 1954 by McGraw-Hill is the Third Edition of **Formulas for Stress and Strain** by Raymond J. Roark, Professor of Mechanics, University of Wisconsin. This thorough revision of a working handbook for engineers concerned with machine and structural design contains a summary of important formulas, facts and principles pertaining to strength of materials.

An indication of Kaiser Engineers' activity is the fact that more than 6,000,000 miles have been flown by key personnel, staying in touch with far-flung activities in widely diversified engineering fields. When you have a problem in design, engineering or construction, call or write: Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

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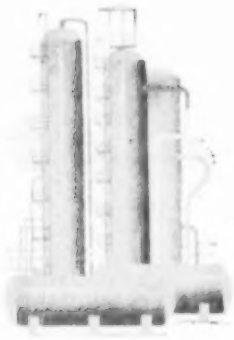

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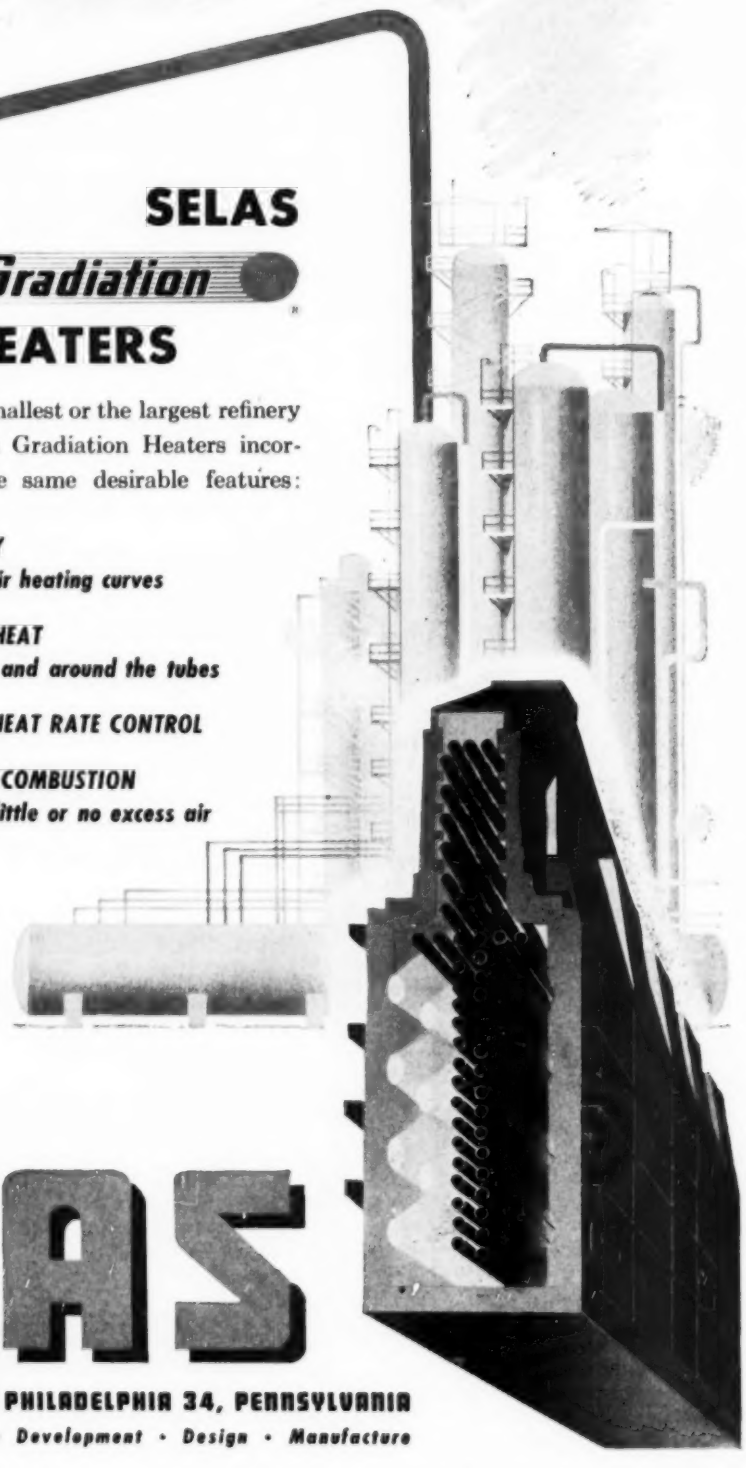

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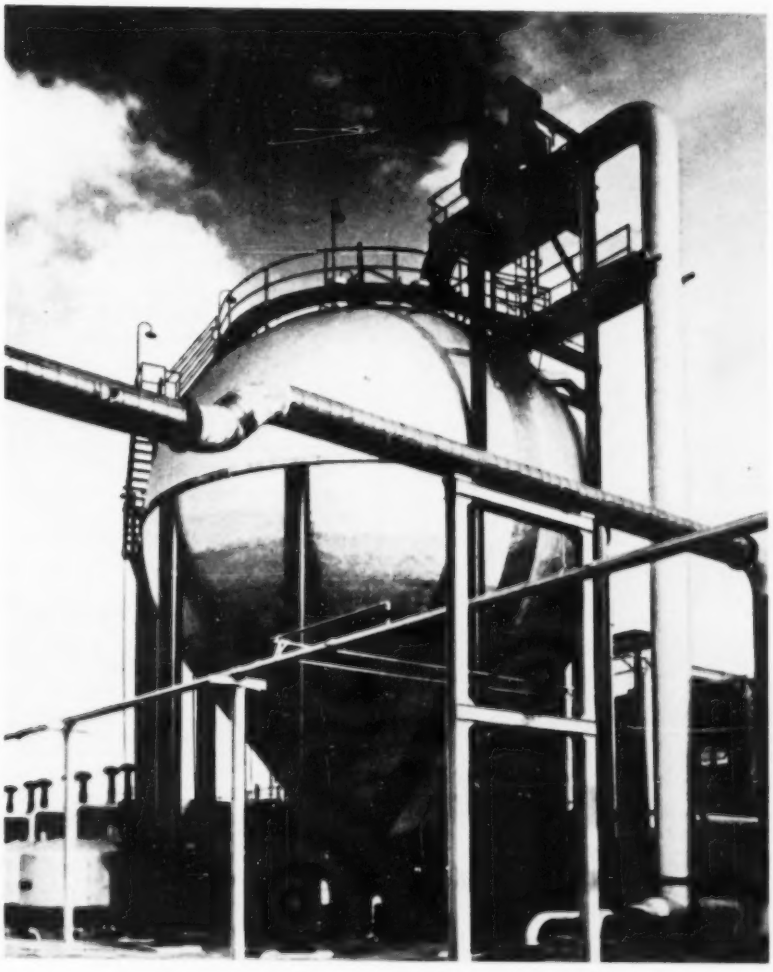

"Sphericone" is Biggest Water Softener

Unique design combining a sphere and cone has been used in the world's largest hot-process hot-zeolite water softener, installed at the Bayway, N.J., refinery of Esso Standard Oil Co. The unit, known as the "Sphericone," was designed and built by Graver Water Conditioning Co., and handles 200,000 gph. of feedwater for 650 psi. boilers. Unit is 60 ft. high and 43½ ft. in diameter. The special shape is said to provide several advantages in obtaining clearer and softer water.

Flexonics Promotes Three

Carl W. Schwendener has been named factory manager of Flexonics Corp.'s Elgin Division, Richard Benton has been promoted to a similar post at the company's Rock Falls, Ill., plant, and Fred A. Abben is the new industrial relations manager.

Mr. Schwendener joined the company in 1943, and for the past five years has been personnel director. Mr. Benton has been with Flexonics since 1940, his most recent post having been production manager of the Elgin Division. Mr. Abben, formerly factory manager at Savanna, Ill., will assume the personnel responsibilities held by Mr. Schwendener.

Markets Oxidation Catalyst

Houdry Process Corp. is handling refinery applications of catalytic oxidation units manufactured by Oxy-Catalyst, Inc.

Developed by Eugene J. Houdry, the catalyst has been used to improve oxidation efficiency and minimize air pollution in a wide variety of industrial applications. Houdry is promoting use of this material in the petroleum industry for recovery of heat from waste cracking gases, and abatement of smog and other nuisances from refinery fumes.

Each oxidation unit consists of ceramic sticks, approximately 6-in. long, coated with an active platinum base film. The sticks are spaced in staggered rows between 3-in. sq. ceramic plates to form "Oxycats." Oxidation occurs at the surface of the sticks as gases flow through the "Oxycats" with little drop in pressure.

De-Control Frees Stainless

Removal of the last BSDA alloy control has released nickel-bearing Carpenter Stainless No. 20 to general industry without restriction. Stainless No. 20 is a sulfuric acid-resisting steel.

Included in the alloys released is columbium, which is added to No. 20 for those applications which involve welding during fabrication and those in which the part must be placed in service in the as-welded condition.

Purchase and sale of columbium-bearing material has been restricted since the beginning of the Korean War, being limited to high priority industrial users. Sole producer of No. 20 in wrought forms such as bar, strip, wire and billets is the Carpenter Steel Co.

Honeywell Cited For School Aid

A citation for 31 years of partnership in a cooperative educational program was recently awarded Brown Instruments Division of Minneapolis-Honeywell Regulator Co. by the Drexel Institute of Technology.

The award was in recognition of assistance given by the division to more than 5000 Drexel students. The program involves alternate periods of on-campus study with periods of employment in industry. Honeywell has been active in this field since 1922.

Water Conditioner Firms Merge

Two well-known firms in the water conditioning business have united: Refinite Sales Co. and Elgin Softener Corp.

Industrial water conditioning products and services of both organizations are now being handled by a combined sales-engineering organization known as Elgin-Refinite, Inc., a newly created division of Elgin Softener Corp. The move, according to company officers, was made to broaden the lines of

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Revolutionize the Service of Fire Protection
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Suppliers

equipment and services previously offered by the individual firms.

New Bechtel Process Head

Bechtel Corp. has named Gordon B. Zimmerman as chief process engineer for all refinery process design, in a move to broaden the scope of the refinery division's work in San Francisco and New York.

Prior to joining Bechtel in 1946, Mr. Zimmerman spent 15 years with Universal Oil Products, supervising pilot plant operations in thermal and catalytic processing and working on development of new refinery processes.

Columbian Switches Offices

Columbian Carbon Co. has moved its executive offices to 380 Madison Ave., New York City. Moving along with Columbian are its subsidiaries, The Frederick H. Levey Co., The L. Martin Co., and a distributing firm, Binney & Smith Co.

Ellsworth Heads Supply Group

M. A. Ellsworth, vice president in charge of sales for Fluor Corp., is the new president of the Natural Gasoline Supply Men's Association for 1954. He succeeds Malcolm E. Duncan of Tulsa, Okla.

Personnel Changes

Precision Scientific Co.—Chester A. Warner to chairman of the board and John J. Kinsella to president, succeeding Mr. Warner. The latter fills the post left vacant by the death of Walter W. Pitann, company founder.

Emery Industries, Inc.—Alexander Moore to development and service department from posts in the production and application research departments, same firm.

American Meter Co.—William N. Donachy and Andrew Sescock to sales representatives, in the Tulsa, Okla., and Billings, Mont., area, respectively.

William Powell Co.—Kemp Pierce and Tom Williams to sales representatives in the Houston, Texas, office.

Tube Turns, Inc.—Richard T. Burke to the Houston, Texas, office as sales engineer, and Earl R. Muir, Jr., to a similar post in the Seattle, Wash., office.

Suppliers

Fluor Corp.—Frederick M. Pyzel to consulting chemical engineer from Shell Chemical Co.

Cooper-Bessemer Corp.—R. G. Williamson to branch manager of the Los Angeles office.

Proto Tools—H. W. Oetjen to sales manager from director of marketing and research.

General Electric Corp.—David J. Jay to engineer in the product and process development section, Carboloy Department.

Bigelow-Liptak Corp.—L. E. Brungraber to the Philadelphia sales offices and Arthur H. Trinkle to the New York office.

The Bristol Co.—Ernest Nuber to sales manager of the Instrument Division from manager of the application engineering department.

Canadian Meter Co.—John T. Young to sales representative for the Western Division of this Canadian subsidiary of American Meter Co.

Pennsylvania Salt Mfg. Co.—James H. Cogshall has rejoined the company as a sales engineer after two years in the U. S. Navy.

Blaw-Knox Co.—E. P. Additon to sales engineer for the company's Chemical Plants Division.

National Research Corp.—Theodore E. Burleigh to sales engineer in the sales department.

Cleaver-Brooks Co. — Elmer H. Wegner to general manager of manufacturing from director of purchases.

Raybestos-Manhattan, Inc.—Joseph N. Kuzmick to coordinator, corporation research and development.

Dresser Industries, Inc.—J. Curran Freeman to controller from an executive post with the Ford Motor Co.

Expansion, Transition

Tube Distributors, Inc., has moved its offices, stock and processing machinery into a specially designed warehouse at Garden City, N. Y.

R. S. Aries & Associates have moved their executive offices to 270 Park Ave., New York City, a location with four times the floor space of their former headquarters.

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One compact valve assembly gives safe, satisfactory relief and protection to storage tanks containing flammable material. This high efficiency unit has excellent flow characteristics. Arrester bank consists of network of capillary openings. Rubber to metal seating means high vapor conservation and gives a quick, tight seal when needed to shut off oxygen supply and automatically extinguish flame. Maintenance time is cut in half; cost is even lower. Let us show you why!

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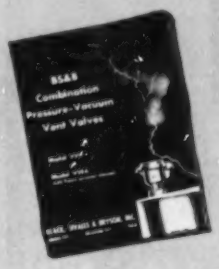

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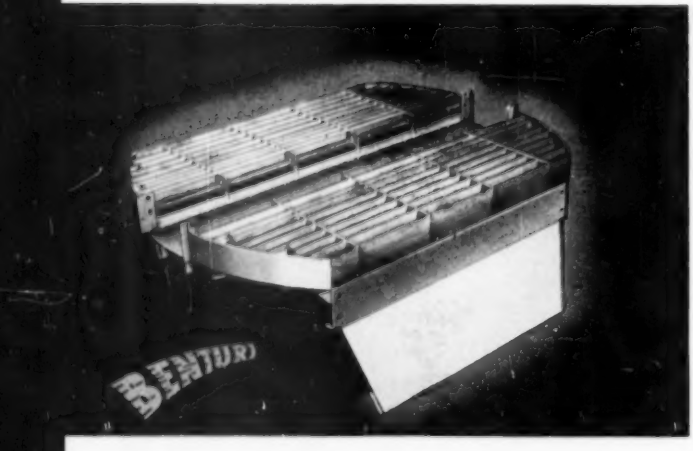

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Paisley, Scotland

Oil Man's Calendar

DECEMBER

American Chemical Society, regional conclave, Jung Hotel, New Orleans, La., Dec. 10-12.

American Institute of Chemical Engineers, annual meeting, Hotel Jefferson, St. Louis, Mo., Dec. 13-16.

American Chemical Society, 1953 symposium on "Flow Through Porous Media", University of Michigan, Ann Arbor, Dec. 28-29.

JANUARY, 1954

Society of Automotive Engineers, annual meeting and engineering exhibit, Sheraton-Cadillac and Statler Hotels, Detroit, Mich., Jan. 11-15.

National Constructors Ass'n, annual meeting, Commodore Hotel, New York City, Jan. 12-14.

American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York City, Jan. 12-14.

Plant Maintenance and Engineering Show, International Amphitheatre, Chicago, Ill., Jan. 25-28.

Texas A. & M. College, symposium on "Instrumentation for the Processing Industries", College Station, Texas, Jan. 27-29.

FEBRUARY

Western Petroleum Refiners Ass'n, regional meeting, Hotel Beaumont, Beaumont, Texas, Feb. 11-12.

Natural Gasoline Ass'n of America, Permian Basin regional meeting, Lincoln Hotel, Odessa, Texas, Feb. 26.

MARCH

American Society for Testing Materials, spring meeting, Hotel Shoreham, Washington, D. C., March 1-5.

Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, William Penn Hotel, Pittsburgh, Pa., March 1-5.

National Ass'n of Corrosion Engineers, 10th annual conference and exhibition, Kansas City Municipal Auditorium, Kansas City, Mo., March 15-19.

Western Petroleum Refiners Ass'n, annual meeting, Plaza Hotel, San Antonio, Texas, March 29-31.

APRIL

National Petroleum Ass'n, 51st semi-annual meeting, Cleveland Hotel, Cleveland, Ohio, April 14-16.

Natural Gasoline Ass'n of America, 33rd annual convention, Baker Hotel, Dallas, Texas, April 21-23.

Ass'n of Consulting Chemists and Chemical Engineers, symposium and banquet, Hotel Belmont Plaza, New York City, April 27.

MAY

American Petroleum Institute, Division of Refining, 19th mid-year meeting, Rice Hotel, Houston, Texas, May 10-13.

2nd Basic Materials Exposition and Conference, International Amphitheatre, Chicago, Ill., May 17-20.

JUNE

American Society for Testing Materials, 57th annual meeting and exhibit of testing apparatus, Sherman and Morrison Hotels, Chicago, Ill., June 14-18.

JULY

1st Western Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif., July 13-15.

AUGUST

5th Symposium on Combustion, University of Pittsburgh, Pittsburgh, Pa., Aug. 30-Sept. 3.

SEPTEMBER

1st International Instrument Congress and Exposition, Commercial Museum and Auditorium, Philadelphia, Pa., Sept. 13-24.

NOVEMBER

American Petroleum Institute, 34th annual meeting, Conrad Hilton Hotel, Chicago, Nov. 8-11.

DECEMBER

American Institute of Chemical Engineers, annual meeting, New York City, Dec. 12-15.

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At left: Jacketed 3-Way Plug Cock.

Below: Cutaway section of Jacketed Cock, showing packing gland construction.

Jacketed Pipe, Pumps, Valves and Fittings . . .

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for maintaining uniform temperatures (hot or cold) in process pipes

Regardless of whether the material is being heated or cooled in the processing, and what heating or cooling medium is being used, H & B jacketed fittings are available for all applications. Steam, hot water or hot oil may be used for heating, cold water or brine for cooling.

H & B can save you money on your jacketed pipe and fitting requirements because we buy all standard size pipe from the mill in carload lots, make our own special flanges in quantities, and are tooled up for making jacketed equipment at lowest possible price. Write for Bulletin J-50.

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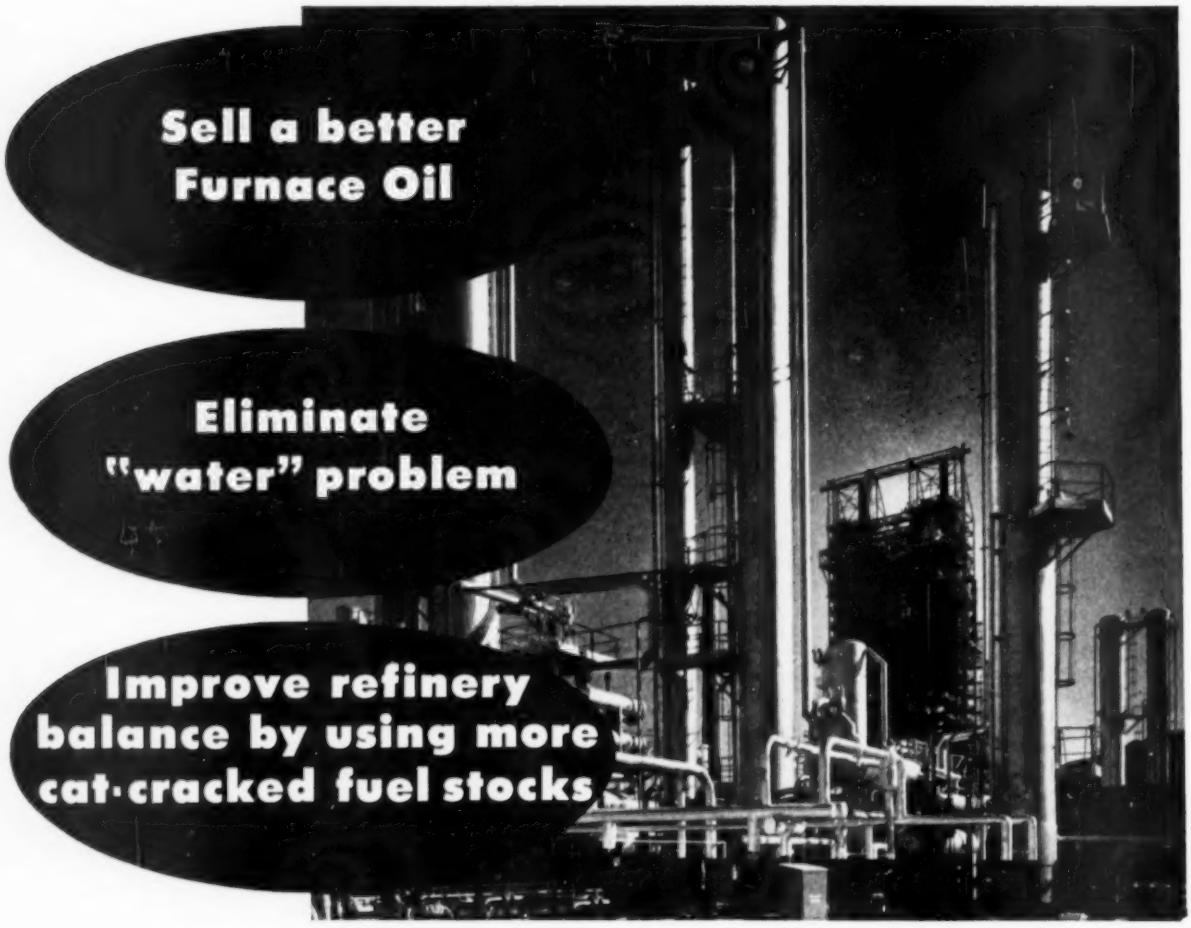

Dispersant FO is a new anti-gumming, rust-inhibiting additive that greatly reduces, even eliminates, deposits and screen clogging in home heating units and storage tanks. Your product with FO will offer dealers many competitive advantages and greatly reduce their number of costly service calls due to clogged filter screens and nozzles.

"Water" is always *the big problem* for the distributor, dealer and home user. The active ingredient in FO is an entirely new chemical, developed especially for use in furnace oils. NEW DISPERSANT FO DOES NOT EMULSIFY WATER WITH BURNER OIL. It will settle the water out of burner oils in short order to provide a "dry" fuel.

Furnace oil with FO has exceptional rust-proofing properties. Steel and iron surfaces in contact with the oil are made corrosion resistant.

This new additive improves stability and permits the blending of higher percentages of cat-cracked stocks without additional gum formation. It improves refinery balance, and you can cut costs by reducing the severity of acid treating of your cat-cracked heating stocks.

The stabilizing action and rust-inhibiting quality of Dispersant FO are obtained at very low dosages. Usually added in the ratio of 1 pint per 1000 gallons of oil stock, at any temperature, prior to shipment by tanker, pipe line or truck.

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THE NAME TO WATCH IN CHEMICALS

2637

Refiners' Heating Oil Inventories Pile Up Through the Mild Fall

Outlook—Crude runs will be pushing at the 7,000,000-b/d ceiling. . . . It will take a cold spell to bring heating oil suppliers into the market in force. . . . Normal seasonal weather will bring a truer picture of what the winter gasoline demand will be.

REFINERY runs continue to be held down in line with the current supply-demand situation. The week ending Nov. 14 was the seventh in which total U. S. runs have been under 7,000,000 b/d avg. Domestic crude oil production also has trended downward, indicating that runs to stills should continue at about present levels.

The unduly warm weather over the country at the start of the home heating season, however, has postponed the withdrawals of heating oils (kerosine and distillate) from primary storage that normally might have been anticipated. Just the reverse, refiners' inventories of these products Nov. 14 were over 170,000,000 bbls., nearly 6,500,000 bbls. higher than on Oct. 3, and representing 66 days' supply of anticipated demand at refineries. In the comparable period a year ago, these stocks were reduced nearly 2,000,000 bbls., and represented 57 days' supply.

Perhaps due to the lower crude runs, gasoline stocks at primary sources have increased only about 1,700,000 bbls. since early October, a smaller increase than in the past two years. However, total U. S. inventories on Nov. 14 were close to 145,000,000 bbls. to start the winter buildup. This was 21,640,000 bbls. higher than on Nov. 15, '52.

Primary stocks of the four principal products, gasoline, kerosine, distillate fuels and residuals, on Nov. 14, were 367,400,000 bbls., over 40,000,000 bbls. higher than on Nov. 15, '52, and by far the highest inventories ever held in refineries, large terminals and pipelines.

A severe cold spell could change the picture for heating oil stocks, particularly in the interior refining districts. Here distillate inventories (see Table 1) in early November were only 4% above a year ago. Refiners may be required to increase their output of distillate fuels substantially. This they could do by increasing their yield of distillates at the expense of their gasoline output, or by running more crude oil to stills. Yields of distillates have been held down this summer because of the wide differential (over 3¢) between distillate and gasoline prices. For the U. S., the average yield of distillates in August (latest figure available) was 19.9%, as compared with over 21.5% early in the year. In the Ind.-Ill.-Ky. district the figure was 17% in August. Gasoline yields have been over 52% this summer in the interior districts and over 45.5% average for the U. S.

The alternative for refiners faced with increasing their distillates output, running more crude to stills, would give them more gasoline to sell this winter but perhaps at the expense of the gasoline markets next spring.

Gasoline: Indicated refinery output in November is down to about that of a year ago, while for the 10 months it is 9.4% higher. Indicated November demand, nearly 8% greater than a year ago, is above the rate of increase for 10 months. The mild fall is holding gasoline demand up, and this does not give a true picture of what later demand will be as related to last winter.

U. S. gasoline stocks Nov. 14 were over 17% larger than a year ago. East of California 14-15% larger. East and Gulf Coast inventories were about in line with this figure; Okla-Kans.-Mo. the most out of line, with inventories 30% larger. California stocks were 40% greater.

Heating Oils: Indicated production the early part of November was nearly 7% less than November, '52, reflecting the current lower yields of distillate fuels, since indicated crude runs were only 1.3% lower. Indicated demand in November was 9.3% less than last year, while 10 months' demand is 1.2% greater than in '52. Combined kerosine and distillate stocks Nov. 14, for the U. S. and East of California, were 13% higher. Stocks on the East and Gulf Coasts were 14% greater.

Runs Edging Toward 7,000,000 Bbls.

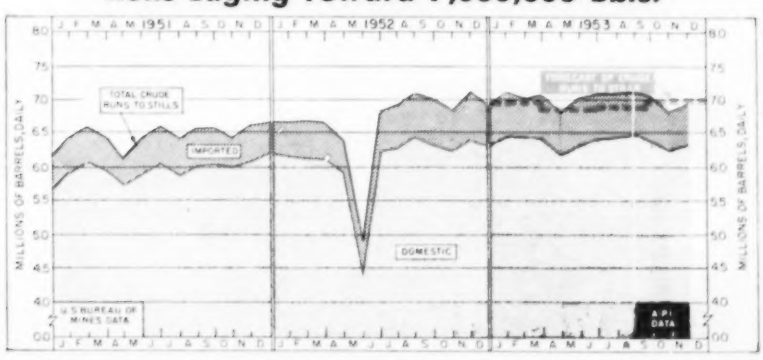


Table 1—Refinery Stocks of Distillate Fuels
Nov. 8, 1952 and Nov. 7, 1953
(Thousand barrels, API Data)

	Nov. 7, 1953	Nov. 8, 1952	Change Amount	Change %
East Coast	50,421	43,183	+ 7,238	16.7
Gulf Coast	24,807	19,968	+ 4,839	24.2
Total Coastal	75,228	63,151	+12,077	19.1
Appalachian	2,385	2,394	— 9	0.4
Ind.-Ill.-Ky.	24,635	22,506	+ 2,129	9.5
Okla.-Kans.-Mo.	12,740	13,629	— 889	6.5
Other Inland	6,322	5,716	+ 606	10.6
Total Inland	46,082	44,245	+ 1,837	4.2
Total East of Cal.	121,310	107,396	+13,914	12.9
California	14,563	12,750	+ 1,813	14.2
Total U. S.	135,873	120,146	+15,727	13.1

Crude Runs to Stills
Daily Average (1000 bbls.)

	Domestic	Foreign	TOTAL
Nov. '53 API*	6,316	640	6,956
Nov. '52 BM	6,420	629	7,049
Change	—104	+11	—93
% Change	1.6	1.7	1.3

* Through Nov. 14.

Total (1000 bbls.)
(Bureau of Mines Data)

10 Mos. '53*	1,935,082	195,124	2,130,206
10 Mos. '52	1,845,479	168,820	2,014,299
Change	+89,603	+26,304	+115,907
% Change	4.9	15.6	5.8

* Sept. & Oct. estimated from API data.

BM Data on Crude Runs to Stills, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

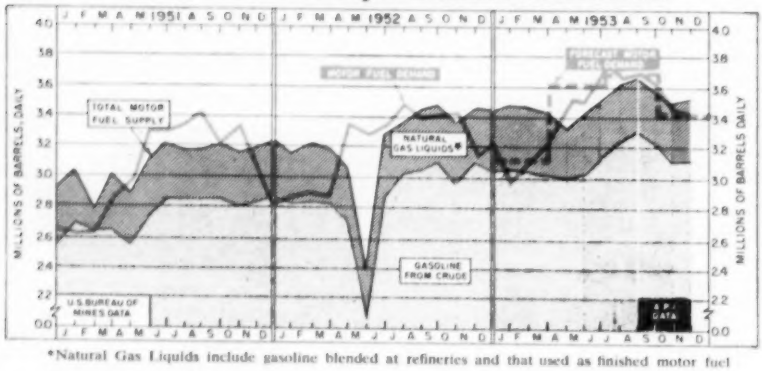
Actual	Estimated	Forecast
1st. Q., 7,006	2nd Q., 6,959	3rd Q., 6,991	4th Q., 7,044

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
Nov. '53 API*	45.1	4.8	20.7	17.0
Oct. '53 API	45.5	5.3	21.1	17.1
Sept. '53 API	45.6	4.6	20.3	17.4
Nov. '52 BM	43.8	5.6	21.4	18.4

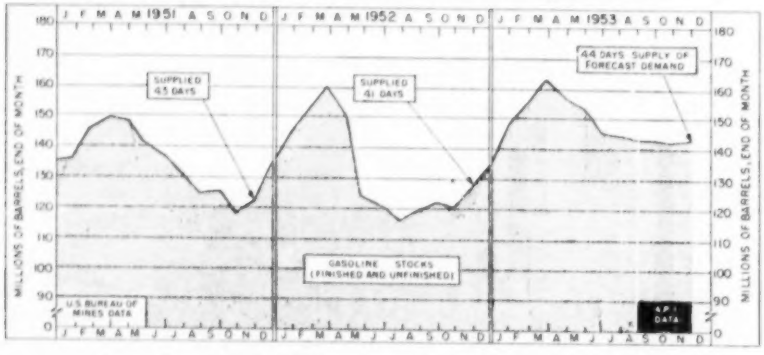
* Through Nov. 14.

Mild Weather Helps Gasoline Demand

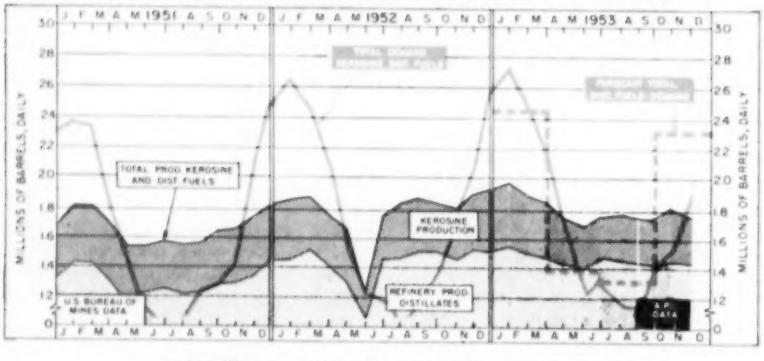


*Natural Gas Liquids include gasoline blended at refineries and that used as finished motor fuel

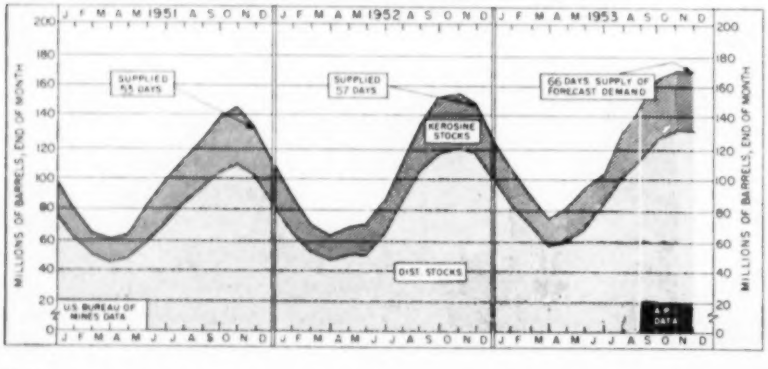
Gasoline Inventories Start Upward


SUPPLIED 45 DAYS
SUPPLIED 41 DAYS
44 DAYS SUPPLY OF FORECAST DEMAND
GASOLINE STOCKS (FINISHED AND UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH

Heating Oil Shipments Under '52 Level



Distillate Stocks Begin to Dip



Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended Used Direct	TOTAL
Nov. '52 API*	3,135	400	3,535
Nov. '52 BM	3,165	391	3,496
Change	+30	+9	+39
% Change	1.0	2.3	1.1

* Through Nov. 14.

Total (1000 bbls.)
(Bureau of Mines Data)

10 Mos. '53*	954,137	116,315	1,070,452
10 Mos. '52	864,145	114,310	978,455
Change	+89,992	+2,005	*+91,997
% Change	10.4	1.8	9.4

* Sept. & Oct. estimated from API data.

Motor Fuel Demand

Including Exports
Daily Average (1000 bbls.)

Nov. '53 API*	3,422
Nov. '52 BM	3,178
Change	+244
% Change	7.7

* Through Nov. 14.

Total (1000 bbls.)
(Bureau of Mines Data)

10 Mos. '53	1,061,312
10 Mos. '52	994,704
Change	+66,608
% Change	6.7

* Sept. & Oct. estimated from API data.

BM Data on Motor Fuel Demand, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

Actual	Estimated	Forecast
1st Q., 3,150	2nd Q., 3,610	3rd Q., 3,674 4th Q., 3,485

Gasoline Stocks

Finished and unfinished, end of month (1,000 bbls.)

Nov. '53 API*	141,954
Oct. '53 API	143,368
Sept. '53 API	142,904
Nov. '52 BM	136,028

* Nov. 14.

Heating Oils Production

(Kerosine and Distillates)
Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
Nov. '53 API*	334	1,437	1,771
Nov. '52 BM	393	1,510	1,903
Change	−59	−73	−132
% Change	15.0	4.8	6.9

* Through Nov. 14.

Total (1000 bbls.)
(Bureau of Mines Data)

10 Mos. '53*	107,691	442,815	550,506
10 Mos. '52	107,447	429,186	536,633
Change	+244	+13,629	13,873
% Change	0.2	3.2	2.6

* Sept. & Oct. estimated from API data.

Heating Oils Demand

Daily Average (1000 bbls.)

	Kero-sine	Dist. Fuels	TOTAL
Nov. '53 API*	419	1,483	1,902
Nov. '52 BM	429	1,679	2,108
Change	−10	−196	−206
% Change	2.3	11.6	9.8

* Through Nov. 14.

Total (1000 bbls.)
(Bureau of Mines Data)

10 Mos. '53 *	96,616	410,166	506,782
10 Mos. '52	101,246	399,536	500,782
Change	+4,630	+10,630	+6,000
% Change	4.6	2.7	1.2

* Sept. & Oct. estimated from API data.

BM Data on Heating Oils Demand, 1953
(July 30, 1953; 1000 b/d avg. by quarters)

Actual	Estimated	Forecast
1st Q., 2,459	2nd Q., 1,398	3rd Q., 1,283 4th Q., 2,321

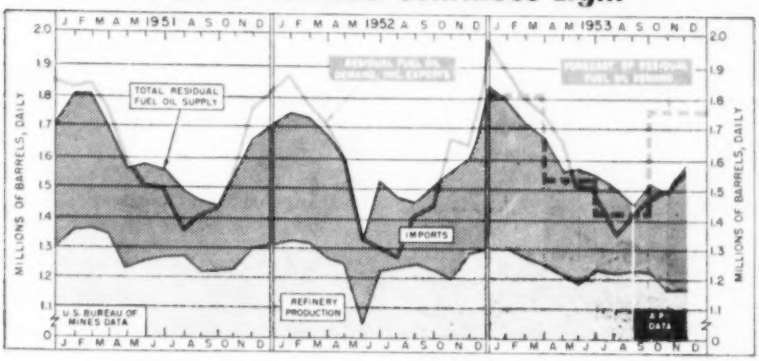
Heating Oil Stocks

(1000 bbls. end of month)

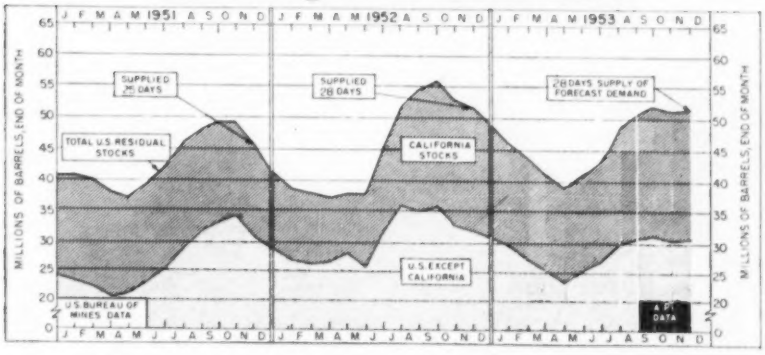
	Kero-sine	Dist. Fuels	TOTAL
Nov. '53 API*	36,779	133,983	170,762
Oct. '53 API	37,963	134,631	172,594
Sept. '53 API	37,116	126,693	163,809
Nov. '52 BM	32,199	116,096	148,295

* Nov. 14.

"Resid" Demand Continues Light


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, DAILY
TOTAL RESIDUAL FUEL OIL SUPPLY
IMPORTS
REFINERY PRODUCTION
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Little Change in Residual Stocks


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BARRELS, END OF MONTH
SUPPLIED 25 DAYS
SUPPLIED 28 DAYS
28 DAYS SUPPLY OF FORECAST DEMAND
TOTAL U.S. RESIDUAL STOCKS
CALIFORNIA STOCKS
U.S. EXCEPT CALIFORNIA
U.S. BUREAU OF MINES DATA
A.P.I. DATA

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Output	Imports	TOTAL
Nov. '53 API*	1,179	414	1,593
Nov. '52 BM	1,299	348	1,647
Change	−120	+66	−54
% Change	9.2	18.7	3.3

* Through Nov. 14.

Total (1000 bbls.)
(Bureau of Mines Data)

10 Mos. '53 *	374,914	108,086	483,000
10 Mos. '52	375,449	101,400	476,849
Change	−535	+6,686	*+6,151
% Change	0.1	6.6	1.3

* Sept. & Oct. estimated from API data.

Residual Fuels Demand

Daily Average (1000 bbls.)

Nov. '53 API*	1,588
Nov. '52 BM	1,664
Change	−81
% Change	4.9

* Through Nov. 14.

Total Demand (1000 bbls.)

10 Mos. '53*	484,935
10 Mos. '52	471,978
Change	+12,957
% Change	2.7

* Sept. & Oct. estimated from API data.

BM Data on Residual Fuels Demand, 1953
(July 30, 1953; 1000 b/d avg. by quarters)
Actual — Estimated — Forecast
1st Q., 1,833 — 2nd Q., 1,542 — 3d Q., 1,429 — 4th Q., 1,748

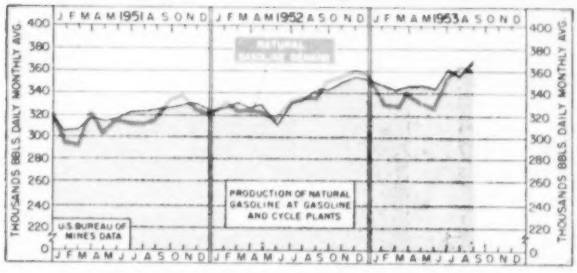
Residual Fuel Stocks

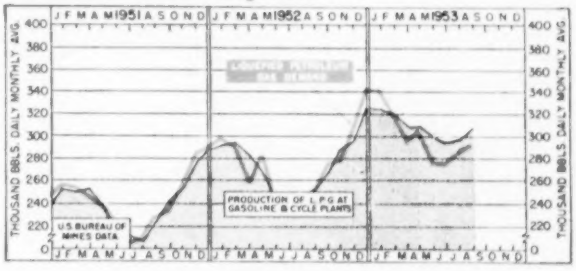
(1000 bbls. end of month)

	U.S. Except California	TOTAL U.S.
Nov. '53 API*	30,561	51,606
Oct. '53 API	30,155	51,538
Sept. '53 API	31,304	51,922
Nov. '52 BM	33,469	53,069

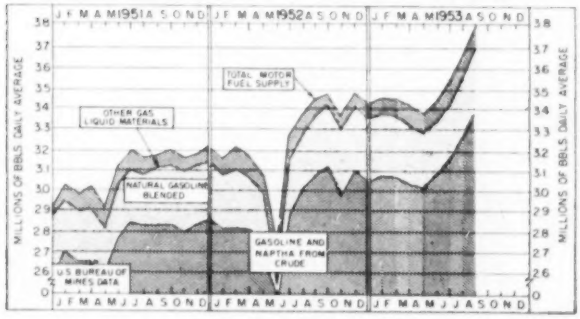
* Nov. 14.

Supply and Demand of Natural Gas Liquids


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
THOUSANDS BBLS. DAILY MONTHLY AVG.
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
THOUSAND BBLS. DAILY MONTHLY AVG.
PRODUCTION OF L.P.G. AT GASOLINE & CYCLE PLANTS
U.S. BUREAU OF MINES DATA

Makeup of Motor Fuel Supply


J F M A M 1951 A S O N D
J F M A M 1952 A S O N D
J F M A M 1953 A S O N D
MILLIONS OF BBLS. DAILY AVERAGE
TOTAL MOTOR FUEL SUPPLY
OTHER GAS LIQUID MATERIALS
NATURAL GASOLINE BLENDED
GASOLINE AND NAPTHA FROM CRUDE
U.S. BUREAU OF MINES DATA

(Figures in table in 1000 bbls./day average)

	Gasoline & Naphtha from Crude	Natural Blended	Other Gas Liquid Materials	Total Motor fuel Supply
Aug. '53	3,394	307	110	3,811
July '53	3,276	307	98	3,681
June '53	3,168	298	99	3,565
Aug. '52	3,088	288	89	3,465

Natural Gas Liquids Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations)

	Supply* (1000 bbls./day avg.) Natural Gasoline	LPG	TOTAL	Demand** (1000 bbls./day avg.) Natural Gasoline	LPG	TOTAL
Aug. '53†	368	307	675	361	292	653
Aug. '52	341	251	592	336	249	585
Change	+27	+56	+83	+25	+43	+68
% Change	7.9	22.3	14.0	7.4	17.3	11.6

	Total Supply (1000 bbls.)			Total Demand (1000 bbls.)		
8 Mos. '53††	85,381	74,758	160,139	84,027	72,911	156,948
8 Mos. '52	80,358	64,587	144,945	80,149	63,054	143,203
Change	+5,023	+10,171	+15,194	+3,889	+9,857	+13,745
% Change	6.2	15.7	10.5	4.8	15.6	9.6

Stocks, End of Month (1000 bbls.)

	By type of product (At gasoline plants and terminals only) LPG	Natural Gasoline	Condensate	Finished Gasoline†	By Location Gasoline Plants	Refineries	Total
Aug. '53	4,638	3,492	284	1,121	9,915	3,044	11,959
July '53	3,579	3,349	290	1,041	8,259	3,003	11,253
June '53	3,155	3,602	255	1,039	8,042	3,012	11,054
Aug. '52	2,805	2,858	261	1,162	7,086	2,636	9,722

* Supply includes receipts from refineries as well as current production from natural gasoline and cycling plants. Receipts from refineries in August included 321,000 bbls. of natural gasoline.

** Demand does not include liquefied refinery gases produced for fuel and chemical purposes, which totaled 2,958,000 bbls. in August.

† Includes naphtha and other products.

Information Offered in the Advertisements

Do you need detailed information on a specific subject? Check through this easy-to-use index of literature and data being offered in this issue's advertisements.

ADDITIVE MATERIALS, petroleum sulfonates: Details; L. Sonneborn Sons, Inc. See adv't p. 1946.

ADSORBENTS, Fuller's earth, activated bauxites: Information; Attapulgus Minerals & Chemicals Corp. See adv't p. 1850.

AIR PREHEATER: Full details; The Air Preheater Corp. See adv't p. 1812.

ALLOYS, nickel-base, corrosion-resistant: Monthly magazine, "Haynes Alloys Digest," offered free; Haynes Stellite Co. See adv't p. 1816.

ALUMINAS, activated, tabular and calcined: Information and samples; Aluminum Co. of America. See adv't p. 1845.

BLENDING EQUIPMENT, automatic, for lube oils; description of a refinery installation: Brochure SM-138; % Proportioneers, Inc.% See adv't inside front cover.

BURNERS, fuel oil, gas: Detailed information; National Airoil Burner Co., Inc. See adv't p. 1963.

CHLORINATION EQUIPMENT, for slime control in process or cooling water: Information; Wallace & Tiernan Co., Inc. See adv't p. 1956.

CORROSION INHIBITORS, for process equipment: Complete information; Tretolite Co. a division of The Petrolite Corp. See adv't p. 1902.

DEAERATING HEATERS: Technical article and bulletins; Graver Water Conditioning Co. See adv't p. 1830.

DRIERS, for instrument air: Booklet "Because Moisture Isn't Pink"; Pittsburgh Lectrodryer Corp. See adv't p. 1857.

ELECTRIC POWER, distribution systems: Installation information; Westinghouse Electric Co. See adv't pps. 1840-1841.

FILTERS, for water, gasoline, oils and other fluids: Bulletin 1152P; Ronningen Manufacturing Co. See adv't p. 1964.

FIRE FIGHTING EQUIPMENT, by spray sprinkler: Bulletin 70; "Automatic" Sprinkler Corp. of America. See adv't p. 1926.

FITTINGS, forged steel, welding and screw types: Literature; H. K. Porter Co., Inc., Watson-Stillman Fittings Division. See adv't p. 1915.

HEAT EXCHANGER TUBES, aluminum brass: Publication B-2; American Brass Co. See adv't p. 1952.

HIGH TEMPERATURE METALS, nickel alloy and other materials: High Temperature Work Sheet; The International Nickel Co., Inc. See adv't p. 1961.

LIQUID LEVEL GAGES, for chemicals: Information; Jerguson Gage & Valve Co. See adv't p. 1908

MIST ELIMINATORS, knitted wire mesh: Catalog; Metal Textile Corp. See adv't p. 1796.

OXYGEN ANALYZERS: Bulletins; Arnold O. Beckman, Inc. See adv't p. 1963.

PACKING, metallic alloy: File No. FPP; Durametallic Corp. See adv't p. 1943.

PROCESSES, for upgrading throughput: Information on Perco; Phillips Petroleum Co. See adv't p. 1834.

PROTECTIVE COATINGS, mastic-type, corrosion-resistant: Catalog; Earl Paint Corp. See adv't p. 1846.

PUMPS, centrifugal; Full information or quotations; Oil Well Supply Division of United States Steel Corp. See adv't p. 1793.

PUMPS, vertical centrifugal: Bulletin "Johnston Volatile Fluid Pumps"; Johnston Pump Co. See adv't p. 1922.

REFRACTORIES: Publication "Basic Materials Booklet"; Norton Co. See adv't pps. 1848-1849.

SEALS, mechanical: File No. FPP; Durametallic Corp. See adv't p. 1943.

STEAM TRAPS: "Armstrong Steam Trap Book"; Armstrong Machine Works. See adv't pps. 1822-1823.

STEAM TRAPS, duo-step leverage: "Duo-Step" brochure; Clark Mfg. Co. See adv't p. 1817.

STEAM TURBINES, for driving pumps: Full details and specification; Dean Hill Pump Co. See adv't p. 1935.

TANKS, calibrating: Bulletin CT-102; Warner Lewis Co. See adv't p. 1929.

TANK CLEANING, with chemicals: Handbook; Oakite Products, Inc. See adv't p. 1962.

TUBE CLEANERS, and expanders: How to save time and money; Airetool Mfg. Co. See adv't p. 1942.

TURBINES, general purpose: Information; Westinghouse Electric Corp. See adv't p. 1852.

VALVE ACTUATORS, motor units, dirt and weather proof: Catalog No. 50; The Chapman Valve Mfg. Co. See adv't p. 1842.

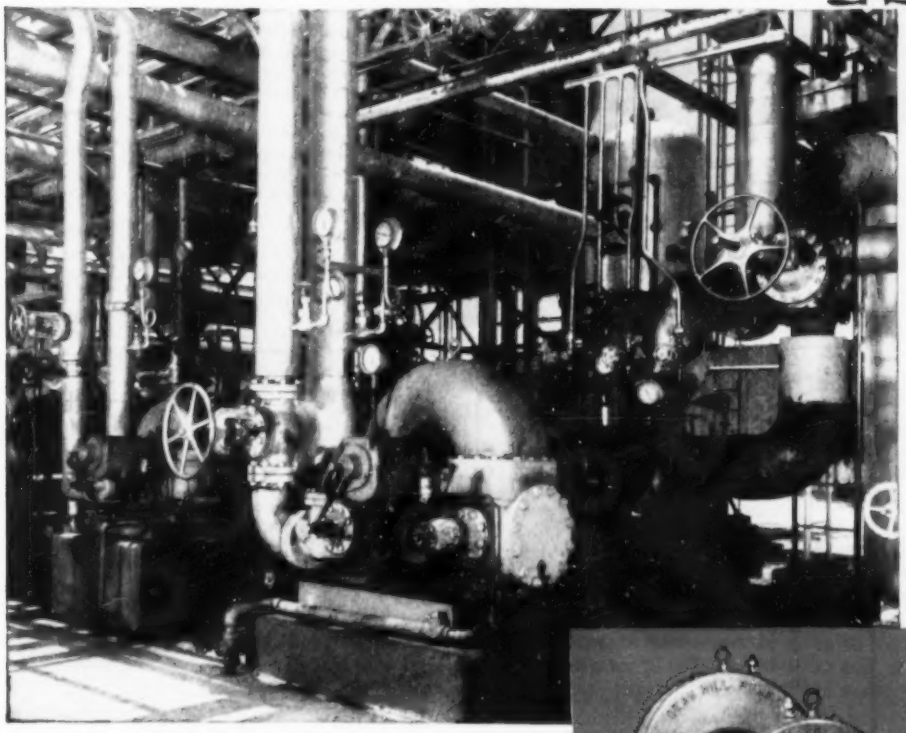
VALVES, control: Catalog "B"; Hammel-Dahl Co. See adv't p. 1805.

VALVES, control: Bulletin 800-1; Minneapolis-Honeywell Regulator Co. See adv't pps. 1828-1829.

VALVES, gate, plug and globe types: Information; The Wm. Powell Co. See adv't p. 1833.

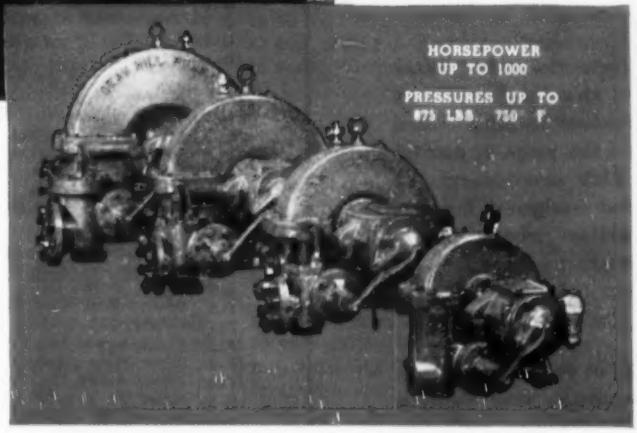
How to stretch a "Power Penny"

You'll never know how much power a penny will buy until you get Dean Hill Steam Turbines on the job. Their super rugged construction, their service-engineered design, their low maintenance, their remarkable power-producing ability all add up to *more power per penny.*



POWER AT WORK

Here are Dean Hill Type DH Steam Turbines at work driving centrifugal pumps at Bay Petroleum Corporation's Chalmette, La. refining operation.



DEAN HILL TURBINES are specifically designed for operation at medium steam pressures. Since they are the single stage, double impact type, low steam consumption is a tremendous economy feature. Steam rates are excellent under these conditions. Get full details and specifications. Write today.

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ADVERTISER'S INDEX

FOR INFORMATION ON ANY PRODUCT OR SERVICE ADVERTISED IN THIS ISSUE SEE INSTRUCTIONS BELOW

Each advertiser listed in this index has been assigned a code letter for use by the reader in securing additional information about advertised products or services which interest him. This code letter appears in parentheses to the left of the advertiser's name.

Circle the code letter on the "Advertised Product Inquiry" card (on the page opposite) which corresponds to that assigned the advertiser about whose product you want further information.

Fill in your name, title, company and mailing address and mail the card . . . no postage is required.

The Petroleum Processing Reader Service Department will give your inquiries prompt and efficient handling.

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(A-2) Air Preheater Corp. 1812
(A-3) Air Products, Inc. 1897
(E-7) Allied Chemical & Dye Corp., General Chemical Div. ..... 3rd Cover
(K-9) Allied Chemical & Dye Corp., Solvay Process Div. 1821
(A-4) Aluminum Co. of America 1845
(A-5) American Bitumuls & Asphalt Co. 1965
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(B-9) Barco Mfg. Co. 1954
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(C-7) Chapman Valve Mfg. Co. 1842
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(D-3) Dean Hill Pump Co. 1935
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(I-7) U.S. Steel Corp., Oil Well Supply Co. 1793
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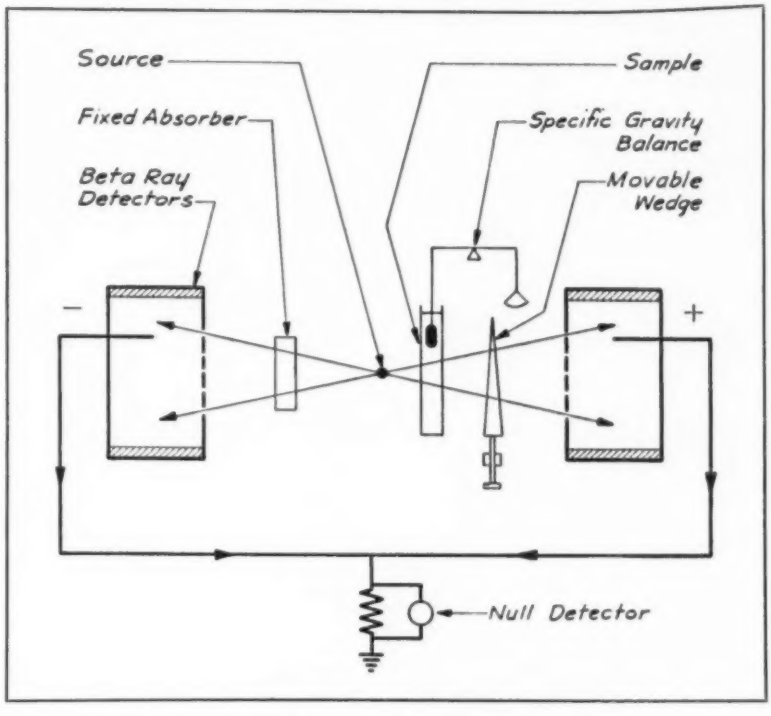
WHAT'S NEW . . .



Meter Reduces Hydrogen Test Time

The new "Cenco Beta Ray H/C Meter," developed by engineers with Standard Oil Co. (Indiana), will measure the percentage hydrogen and the hydrogen-carbon ratio in liquid hydrocarbons by a process using the absorption of beta rays. As a laboratory control test it reduces test run time from four hours to five minutes and simultaneously increases accuracy by more than 100%.

Hydrogen content in hydrocarbons is becoming an increasingly important determination in petroleum processing operations — notably reforming and hydrogenation. The new device is offered as a replacement for the conventional combustion train method. A statistical probable error of 0.02 wt.-% hydrogen has been attained in pilot runs with the new meter. Combustion technique tests usually result in errors up to 0.05, it is said.

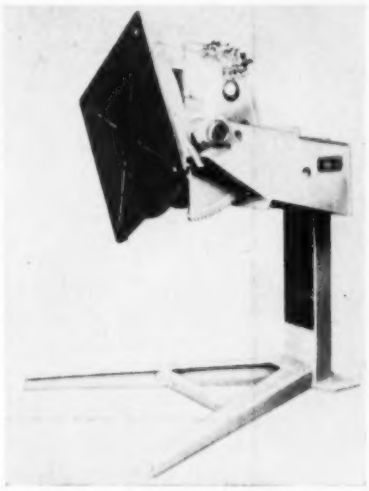
Operation of the new instrument is illustrated in the drawing. A beta ray source (strontium 90, which has a half-life of 25 years) radiates into two ionization chambers as detectors. One of its paths travels through the hydrocarbon sample and a wedge-shaped absorber. A galvanometer indicates the difference in magnitude of the currents produced in the two ionization chambers. The density of the sample is measured simultaneously by the usual weight displacement method. Position of the wedge absorber is recorded precisely and values for wedge position calibrated in terms of H/C ratio.

Safeguards have been incorporated in the instrument design to prevent stray radiation from the strontium 90. The instrument has a selling price of $7860. Central Scientific Co., 1700 Irving Park Rd., Chicago, Ill.

Circle No. **1** *on Reply Card*

For More Information

Use one of the attached reply cards to request additional details or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers at the end of each item in which you are interested. Then fill in the rest of the card and drop it in the mail. No postage is required.



Positioners for Automatic Or Manual Welding

. . . have variable speed drive, and are being built in 2500, 3000 and 6000 lb. capacities. The differential type drive, with all components mounted on ball bearings, provides stepless change from 0 to predetermined top speed. A calibrated hand wheel or electric remote speed control is furnished. Table on these positioners is driven by a spur gear and pinion for minimum backlash and most accurate adjustment. A built-in high capacity ground gives resistance-free return of the welding current, resulting, it is said, in more uniform yields. Table tilting speed is 135° in 40 sec., with table height adjustable in 6-in. steps for handling various sizes of work. Worthington Corp., Harrison, N. J.

Circle No. **2** *on Reply Card*

Carbon Filteraid Screens Alkaline Solutions

. . . yielding a wet filter cake having a density of 18-21 lb./cu. ft. "Nerofil" is a free-flowing black powder which is said by the manufacturer to provide the high porosity and permeability that diatomaceous silica offers, with special properties of complete resistance to alkaline solutions which this latter material lacks. Combustibility which simplifies filter cake disposal is cited as another advantage in "Nerofil's" use. Production is currently coming from a pilot plant operation, with shipments in carload quantities. Expanded production is predicted as demand develops. Great Lakes Carbon Corp., 18 E. 48th St., New York 17, N. Y.

Circle No. **3** *on Reply Card*

Polyethylene Drums Cut Bulk Shipping Weight

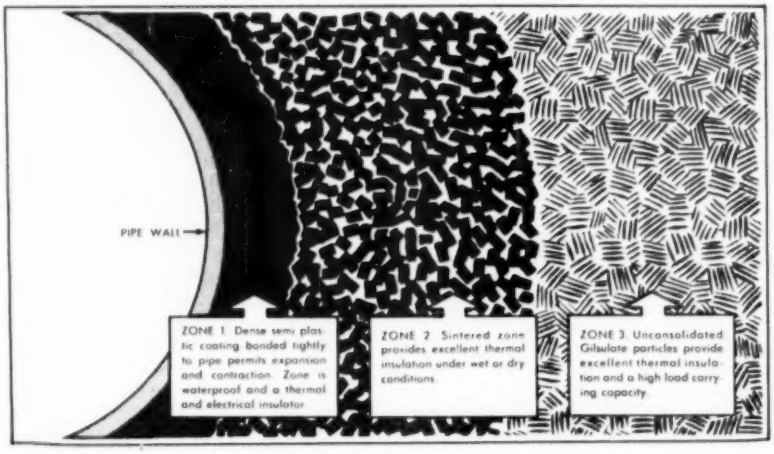
Shipping drums for industrial acids and bulk chemicals are now being molded from "Bakelite" polyethylene. The manufacturer says use of these light weight containers will reduce shipping costs by an estimated 40-50%.

Containers are being produced in 5, 15, 30 and 55 gal. sizes, and are classified as drums by the ICC. In a steel overpack they are assigned about half the usual freight tariff assessed regular 13½-gal. glass carboys. The 55-gal. drum, said to be the largest container ever molded from polyethylene, is said to hold as much as four 13½-gal. conventional glass carboys, but weighs only about one-fifth as much. The drums are designed to fit standard fiber, plywood and steel overpacks.

Another selling point stressed by the manufacturer is that the containers resist the corrosive action of such industrial acids as muriatic and hydrofluoric, caustic soda solutions and electrolyte fluid. They are said to be reusable without reconditioning. Sidewalls of the seamless units are 1/16-in. thick, with top and bottom a bit thicker. Two flanges also made of polyethylene have standard thread openings to accommodate 2-in. and ¾-in. drum plugs. Flanges are equipped with bottle cap threads on the outer surface which fit regular screw caps. With a tare weight of 1½-lb. when shipped empty, the 5-gal. drum fits into a standard corrugated carton.

Bureau of Explosives, which will now issue ICC permits for use of the drums with a steel overpack, is expected by the company to authorize application of the unit with fiber and plywood overpacks shortly. Development of the new type drum to the point where it will require no overpack of any kind is the aim of the manufacturing firm. Delaware Barrel & Drum Co., P. O. Box 1648, Wilmington, Del.

Circle No. **4** *on Reply Card*


PIPE WALL
ZONE 1 Dense semi plastic coating bonded tightly to pipe permits expansion and contraction. Zone is waterproof and a thermal and electrical insulator
ZONE 2 Sintered zone provides excellent thermal insulation under wet or dry conditions
ZONE 3 Unconsolidated Gilsulate particles provide excellent thermal insulation and a high load carrying capacity

Petroleum Product Protects Hot Underground Pipes

"Gilsulate," a blend of specially sized and selected Gilsonite, a crude solidified petroleum, is now being processed and marketed as a protective material for hot underground pipes.

It is said to offer hot lines a triple layer of protection. When the first layer of "Gilsulate" is poured, it melts and fuses to the pipe. Outside this first zone a layer of sintered "Gilsulate" particles is placed. Finally a third zone of unconsolidated "Gilsulate" is packed in place.

Zone one is a dense, semi-plastic coating which permits pipe to expand and contract and acts as a thermal and electrical insulator. It, along with zone two, is water-proof. Zone two gives thermal insulation under wet or dry conditions. Zone three gives thermal insulation and a high load-carrying capacity. No sleeves or sheaths are necessary to protect insulation, and rocks need not be removed from backfill to avoid puncturing insulation.

The product is supplied in three

grades, type A for temperatures of 220-310° F., type B for 300-385° F. and type C for 385-520° F. The three grades have a different initial melting point at which the plastic zone is formed.

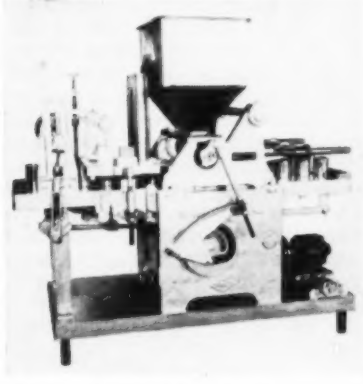
Gilsonite, the crude material, superficially resembles asphalt, but differs in components and characteristics. It is believed to have been formed from the polymerization of heavy petroleum. American Gilsonite Co., 248 S. Main St., Salt Lake City 1, Utah.

Circle No. **5** *on Reply Card*

Perforated Plates or Discs For Tower Packing Support

. . . are available in thicknesses up to 1 in. and over. "Kel-F" discs can be obtained in various hole sizes and perforation patterns to meet specific requirements. Raschig rings are supplied to complete the unit. Manufacturer says the rings can be reclaimed or recycled by the use of any inorganic material or acid, should the process require it. United States Gasket Co., Camden, N. J.

Circle No. **6** *on Reply Card*



Machine Fills Chemical Containers, Puts on Lids

. . . and presses them firmly in place in one continuous operation. Fully automatic, the unit can fill two lines of ½-pint, one pint, quart or gallon cans with paint, oil, chemicals

Where corrosion...temperature...pressure cause other valves to fail . . .

THEY'RE "STICK-PROOF"

Operate Instantly...Everytime...Anytime

For more than 20 years, in practically every type of industry, HOMESTEAD LEVER-SEALDS have been giving trouble-free performance in services where extremes of temperature or pressure or corrosive line fluids cause ordinary valves to "stick" or "seize."

HOMESTEAD Lever-Seald PLUG VALVES are "Stick-Proof" because they're "Lever-Seald," which means that a powerful lever-and-screw device, built into every valve, assures positive action at all times under all conditions.

They operate fast, too—full open or closed by a quarter-turn; and because all operating parts are protected from line fluids, service conditions and weather, they last longer and cost less to maintain.

We make them in metals and alloys to suit your requirements in sizes 1½" to 12", for pressures from vacuum to 1500 lbs. and for temperatures ranging from 40° below zero to 1100° F.

note these exclusive HOMESTEAD features

- Instant Stick-Proof operation.
- Quarter-turn fully opens or closes.
- Positive seal without lubrication.
- Seating surfaces always protected in both open and closed positions. Corrosion practically eliminated.
- Unobstructed straight-line fluid flow.
- All operating parts protected from damaging effects of service conditions and weather.

For Complete details and prices, write today for your copy of VALVE REFERENCE BOOK No. 39-3. No obligation.

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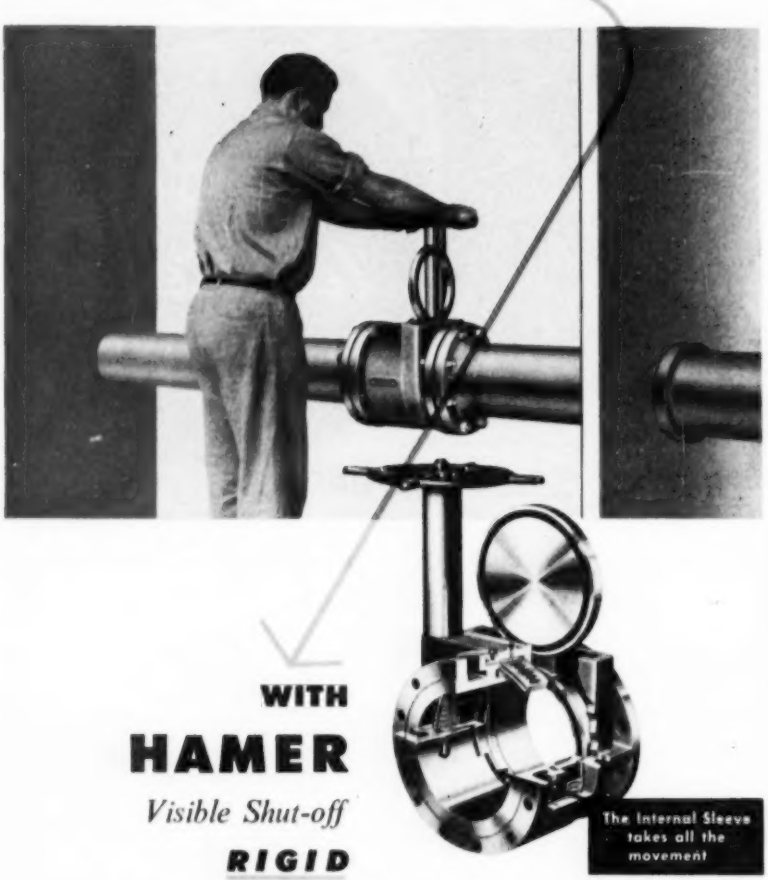
"Serving Since 1892"

P. O. Box 43 Coraopolis, Pa.

You can blind

RIGID *lines*

the speedy, cost-cutting way...



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Visible Shut-off

RIGID

LINE BLIND VALVES

HAMER *Plug Valves*

Thousands of users have proven the easy and immediate operation of HAMER plug valves. Will not stick or freeze.

Hamer "Rigid" Line Blinds solve the problem of blinding pipe lines where no endwise movement of the line is possible. An internal sleeve, actuated by ball-bearing ring gear, takes all movement. Rigid body is unaffected by misalignment or line strains. Enclosed plate slot prevents spillage– stops mess, fire hazard. Blind is easily opened, or closed by one man in one minute.

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HAMER OIL TOOL COMPANY

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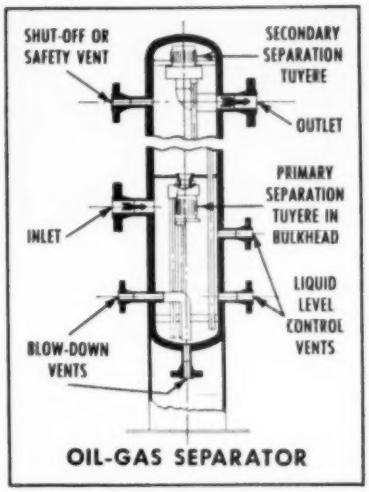
Representatives throughout the United States

or similar viscous products. Containers do not have to be raised or lowered for the filling, capping and pressing operation. Production on the combination unit is from 20 to 50 cans per min. Changeover from one size container to another, or one product to another, is said to take only a few minutes. Contact parts are bronze, but where corrosion resistance is necessary, stainless steel can be used. Casters can be added to permit rolling the unit to production lines. Hopper capacity is 33 gal. Filler Machine Co., Philmont Club Station, Pa.

Circle No. **7** *on Reply Card*



OIL-GAS SEPARATOR

Dual Centrifugal Tuyere Gives Oil-Gas Separation Efficiency

. . . of 99.5 - 99.9%. Design adaptation permits use of the two-stage unit on distillation vessel outlets and also in gas lines. The unit consists of an all-welded cylindrical pressure chamber located in a vertical position. The vessel contains a bulkhead in which an up-flow type primary separating tuyere is located. Above the bulkhead at the top of the chamber is a down-flow type tuyere which effects second-stage separation. An eject tube extends from the tuyere race down through the bulkhead to below liquid level in the bottom primary chamber. Liquid level control in the primary chamber is achieved by two flanged pipe vents located on separate levels to give control depending on working pressure of the still or line. Blow-down connections at side and bottom permit removal of sediment either continuously or intermittently. Final separation is made in the upper portion of the vessel. Gas passes through the down-flow tuyere where residual entrainment is extracted and

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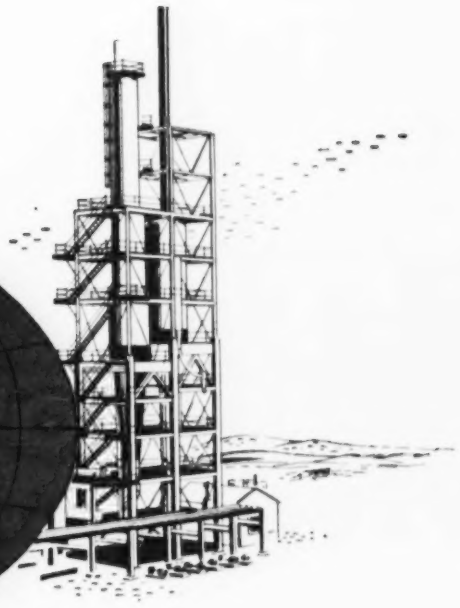
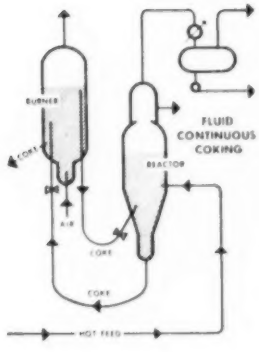
will build the
WORLD'S FIRST FLUID COKER





FLUID COKING

Fluid Coking is a continuous coking process, recently perfected by the Standard Oil Development Company after four years of research. Heavy residual fractions can be cracked for higher yields of light products — far beyond the limits of delayed cokers. Fluid cokers supply their own heat, no furnace is required, coke yields are less and over-all costs are lower. For details on Fluid Coking, contact your Fluor representative.

FOR IMMEDIATE RELEASE:

"BILLINGS, MONTANA,... CONTRACT FOR A NEW FLUID COKING UNIT, FIRST COMMERCIAL INSTALLATION OF ITS KIND IN THE WORLD AND A PROCESS WHICH WILL GREATLY INCREASE THE GASOLINE, TRACTOR AND DIESEL FUEL OUTPUT AT THE CARTER OIL CO. REFINERY HERE, HAS BEEN LET TO THE FLUOR CORPORATION, I. J. STAID, MANAGER OF MANUFACTURING FOR CARTER, ANNOUNCED TODAY.

"WHILE ACTUAL CONSTRUCTION OF THE NEW UNIT WILL NOT BEGIN UNTIL SPRING, ASSEMBLING OF MATERIAL AND DETAILED ENGINEERING WORK WILL GET UNDERWAY IMMEDIATELY...STAID INDICATED THE UNIT IS THE FIRST STEP IN EXTENSIVE MANUFACTURING DEPARTMENT EXPANSION... THE CARTER UNIT PROBABLY WILL BE COMPLETED AND READY FOR OPERATION BY OCTOBER OF 1954."

BE SURE WITH

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ALWAYS a good job well done...

with AIRETOOL tube cleaners and expanders

For really effective tube cleaning in any refinery unit, tools must have power—power to rapidly and efficiently remove hard-rock coke deposits. AIRETOOL high speed motors have that power. Ball bearing thrusts at both front and rear assure constant torque at all speeds—loaded down to as low as 50 RPM, they will not bog down or stall! All AIRETOOL motors are tough but still easily maintained; all parts are ground to a slip-fit requiring no special tools. See how easily you can save time and money on tube maintenance; write to The AIRETOOL Manufacturing Co., 336 S. Center St. Springfield, Ohio.

AIRETOOL series "6000" ball bearing motor, shown with single expansion type cutter head for thoroughly cleaning coke from straight tubes.

There's an AIRETOOL TUBE CLEANER and TUBE EXPANDER for Every Type of Tubular Construction

Solve tube expansion problems

For accurate, consistent rolling of condensers or heat exchangers, tube ends, AIRETOOL Tube Expansion System automatically rolls joints to uniform and maximum tightness, eliminating all possibilities of over-expansion of tubes and distortion of tube sheet.

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SPRINGFIELD, OHIO

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Branch Offices: New York, Tulsa, Philadelphia, Houston, Baton Rouge, Chicago, Hudson Heights, N. J.

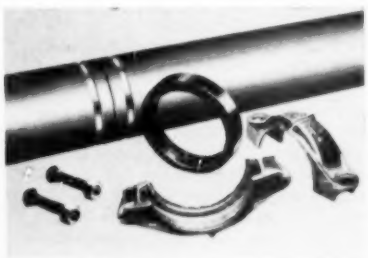
returned to the lower chamber by means of the eject tube. Units may be designed to operate at a variety of temperatures up to 600° F. and pressures up to 3000 psi. Centrifix Corp., 3608 Payne Ave., Cleveland 14, Ohio.

Circle No. **8** *on Reply Card*

Pipe Thread Sealing Compound Prevents Spiral Wicking

. . . and leakage. "T-Film" is chemically inert, having a base of duPont "Teflon," and is said to be suitable for metallic and plastic threaded connections in all types of process pipe lines and apparatus. Because of the base material's non-adhesive characteristics, the compound is said to give a leak-proof joint which is easily broken when necessary without galling or sheared threads. Two consistencies are offered, a light bodied variety for precision threads, and viscous consistency for manual application. Both are stated to be suitable for all chemicals to which the base product is inert and for temperatures up to 400° F. Eco Engineering Co., 12 New York Ave., Newark, N. J.

Circle No. **9** *on Reply Card*



Grooved Pipe Coupling Weighs 40% Less

. . . than conventional models, it is said. "Gruvajoint" is designed to

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...the Pacemaker in Soya Research is your most reliable source for Soya Ingredients

℞ Use the PROVED Soybean Additive

GLIDDOL by Glidden

● Here is the finest soybean additive that can be used to improve the performance of lube oil, fuel oil, grease or gasoline. From the first shipment, Gliddol has been made under rigid laboratory control to prescription standards.

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SOYA PRODUCTS DIVISION
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Durametallic is geared to engineer or produce the very best in metallic packings and mechanical seals for refineries, chemical plants, pipe lines, ships, power, synthetic rubber and general industry. . .

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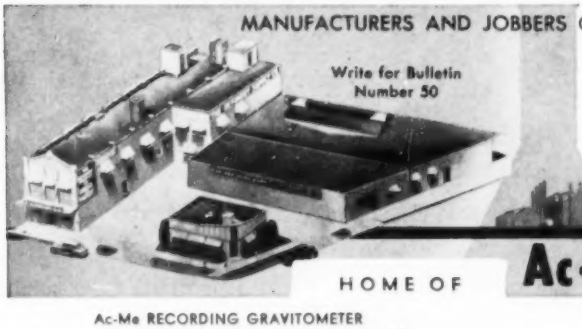
KALAMAZOO MICHIGAN



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SOMEDAY . . . *it will be for real!*

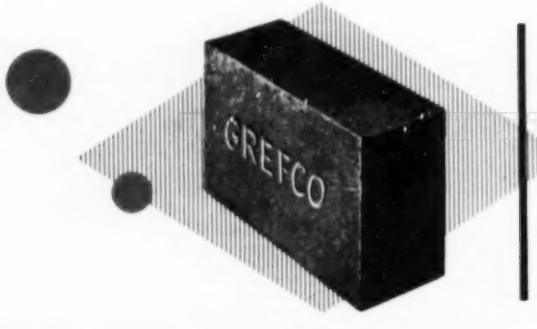
Building with blocks is as much a part of a young boy's life as baseball will be in his teens. Blocks—one on top of the other—to satisfy the typically male urge to create.

As the years roll by, this boy will go on to build bridges or buildings, to make his career in the laboratories of chemical research—or to watch steel being born from ore and earth.

Whatever his future, there will be refractory brick to help him do his job. Blocks of brick to line the furnaces and heat containing vessels—in virtually every step of industry.

There would be no processed raw materials, no production, no living such as we know it but for refractory products which Grefco furnishes in quality and quantity to keep the nation on the move.

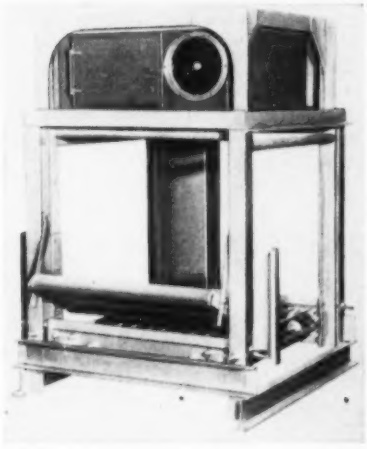
To the boy above, a very Merry Christmas and a great many Happy and Prosperous New Years. In his hands lies the future of America.



GENERAL REFRACTORIES COMPANY
Philadelphia

save installation time, space and weight on systems where pressures do not exceed 500 psi. It's claimed the malleable iron couplings automatically absorb expansion and contraction, ground motion and vibration, remaining leakproof under end pulls up to 7500 lb. The units permit layout misalignment up to 3°, and withstand temperatures ranging from —65° to 200° F. A green rust inhibitor protects the surface, while the sealing gasket is resilient synthetic rubber. Units are obtainable in 2-in., 3-in. and 4-in. sizes. Gustin-Bacon Mfg. Co., 210 W. 10th St., Kansas City, Mo.

Circle No. **10** *on Reply Card*



Check Scale Separates Off-Weight Containers

. . . from properly filled packages by utilizing a two-way conveyor belt. Independently adjustable tolerance settings establish overweight and underweight limits. "Model 200S Checkweight Scale" consists of an enclosed electro-mechanical weighing apparatus and a motor-driven conveyor belt. The belt is made of heavy cadmium-plated steel slats and hangs from the scale platform. A dial indicator on the scale shows the amount each package or drum is overweight or underweight, and additional indicators may be installed at remote control stations. For added control, a horn within the scale sounds as each off-weight container is discharged. Colored signal lights can also be used. Custom-built check scales of this same general type are available for special applications. Thayer Scale and Engineering Corp., E. Water St., Rockland, Mass.

Circle No. **11** *on Reply Card*

READY FOR ACTION WHENEVER YOU NEED IT!
SAFE... SURE PROTECTION
because it's
NATIONAL
AER-O-FOAM
LIQUID
FIRE TESTED
TAKE THE GUESSWORK OUT OF FLAMMABLE LIQUID FIRE-FIGHTING
National AER-O-FOAM is fire-tested . . . checked and proven on actual flammable liquid fires, for split-second, positive, fire-smothering action in your plant. Don't take chances with flammable liquid hazards. Insist on fire-tested National AER-O-FOAM, and be sure of complete, dependable protection.
Send today for your free copy of the fact-filled booklet, "What is Foam, and How to Use It." No obligation, of course.
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HIGHLY REFINED PETROLEUM SULFONATES

✓ emulsifiers
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It is to your advantage to understand the properties of SONNEBORN'S new petroleum sulfonates, because

different types and new grades developed within the past few years now permit

a wide range of new applications, for which sulfonates were previously not considered.

Let us send details of what SONNEBORN now has to offer . . . and help you find the answer to a need.

HYPONATES (oil-soluble, oil-free)

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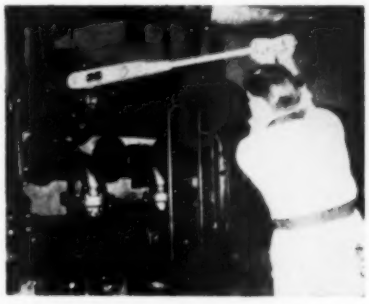
ISOPETRONATES (low viscosity)

Achieved by Sonneborn RESEARCH 1903 • 1953

L. SONNEBORN SONS, INC.
New York 10, N. Y.

What's New!



Torque Wrench Has Capacity Of 0 to 1000 Ft. Lb.

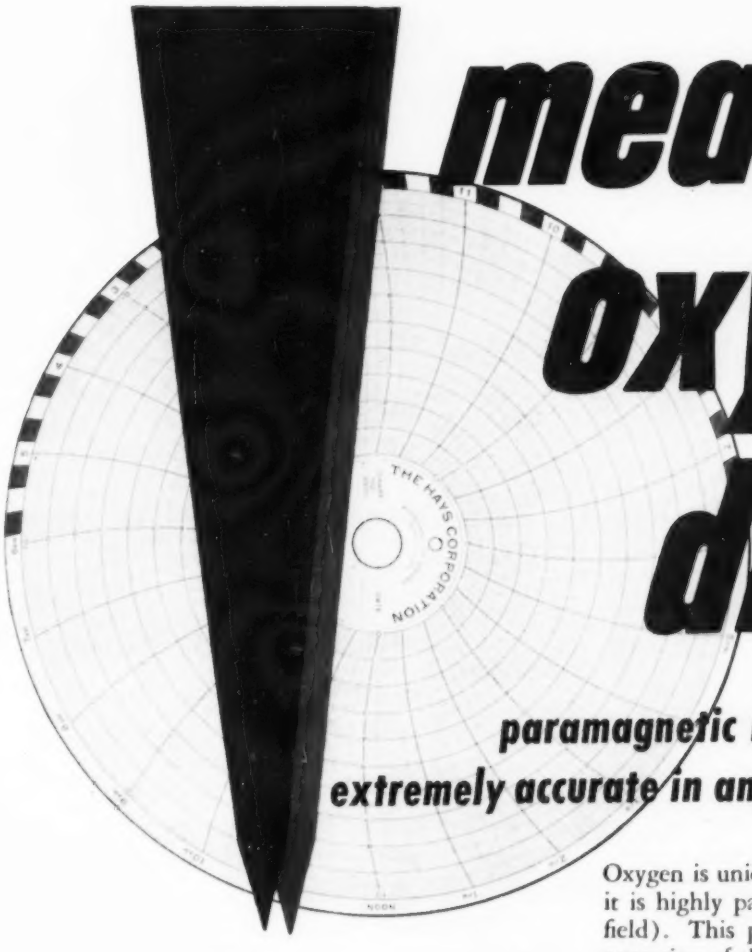
. . . and contains a dial which registers torque reading and remains at maximum after tension is released. The "Stay-Set" dial can be reset by turning the center knob. It's pointed out that the instrument should have special value where heat and pressure are involved, since correct torquing is more important because of increased stress on each part caused by expansion. Manzel Division, Frontier Industries, Inc., c/o 374 Delaware Ave., Buffalo, N. Y.

Circle No. **12** *on Reply Card*

Magnetic Stirrer Eases Laboratory Space Problem

. . . particularly in the close quarters necessary for organic syntheses. "Flexa-Mix" is less than 2¾-in wide and only 4¼-in high. Magnetic lines of force do the work, eliminating the shaft and impellers of mechanical stirrers and permitting full access to the top of the sample container. A small magnetic bar placed inside the sample container, revolves at the same speed as the stirrer motor. Any type of non-magnetic container can be used, and

measure oxygen direct



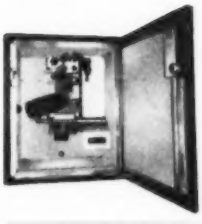
paramagnetic method of measurement extremely accurate in analyzing industrial gases

Oxygen is unique among other common gases in that it is highly paramagnetic (attracted into a magnetic field). This property of oxygen is the basis of the operation of the Hays Magno-Therm Analyzer in the analysis of industrial gases.

application

Hundreds of companies are using the Hays Magno-Therm O_2 Analyzer and Recorder in applications from revivification of SO_2 removers in manufactured gas industry and regeneration of catalysts in oil refineries to mixing air with propane to get substitute fuel. Boiler plants use it as a combustion guide because it is the only means of getting an undistorted picture of excess air.

Write today for bulletin 52-829-56 and get complete details.



ANALYZER

Highly sensitive to changes in oxygen content.

Rapid response to changes in oxygen content.

No liquid or gaseous fuel required to be added to gas sample.

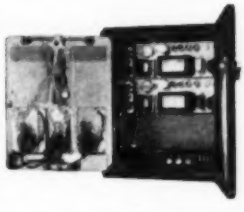
No chemicals required.

High accuracy maintained.

Not affected by wide variation in rate of flow of gas sample.

Rugged construction. No delicate or moving parts.

Easily installed — no special fittings required.



RECORDER

Self-balancing bridge circuit assures accurate, permanent calibration.

Electronic amplifier has no moving parts. High sensitivity. Rugged.

Immediate response—analyzer is continuously connected to recording pen drive motor.

As many as four analyses can be recorded on the same chart.

Range can be changed easily in the field.

Isolating transformer for each amplifier removes line interference from bridge circuit.

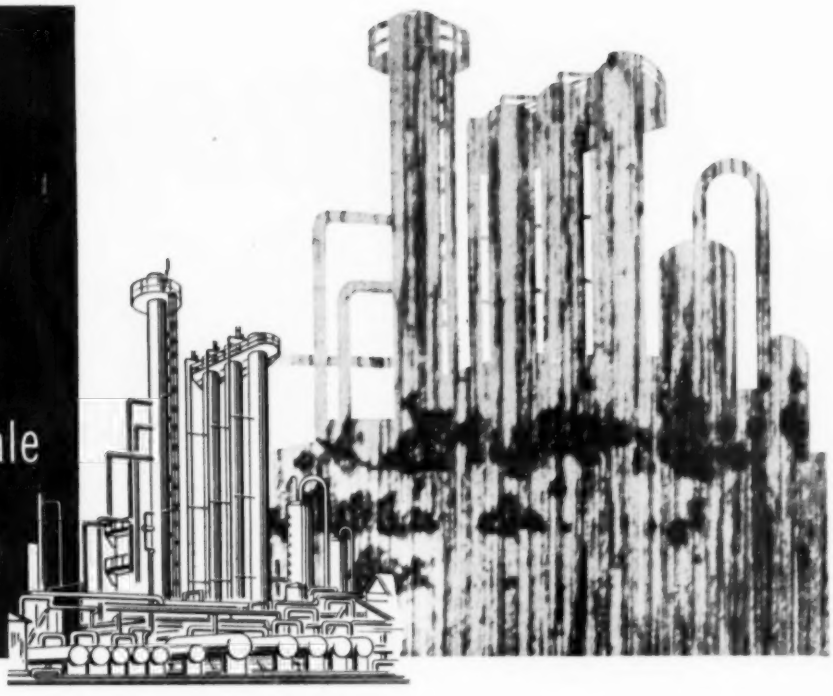
Extra slide wire available for control, remote indication—for recorder or contacts for alarm circuit.

Automatic Combustion Control Boiler Panels • CO_2 Recorders Veriflow Meters and Veritrol Gas Analyzers • Draft Gages Combustion Test Sets Electronic Oxygen Recorders Electronic Flowmeters Electronic Feed Water Controls Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY, INDIANA

Here's a SURE Way to Beat Water-side Scale and Corrosion



The best way to prevent scale and corrosion in cooling water systems is to lick these problems before they start. The results will pay off in high operating efficiency.

For example, water treatment was begun as an initial program for a 50,000 gallon per minute circulating cooling water system of a southwestern refinery. Since the make-up water was obtained from wells of high hardness, high alkalinity and high silica content, Betz Engineers recommended immediate steps to prevent trouble. Careful control of acid, chemical treatment and cycles of concentration was established to avoid scale and corrosion problems, and to maintain an economical blowdown and treatment rate. The newly developed Dianodic* method was employed.

Results after four years of operation justify the preventive maintenance and care which has been taken. Heat exchange surfaces are free from both scale and corrosion, except at some isolated points of poor flow. Corrosion test specimen data show average penetration values of 0.0004 inches per year. Maintenance on the water side is negligible at the annual turnaround and inspection.

*Betz Service Mark

The Dianodic method, developed by Betz Engineers, is a system of combining two anodic inhibitors in such a way as to effectively eliminate pitting and tuberculation and at the same time provide protection against general corrosion and scale.

Why not ask a Betz Engineer how the Dianodic method can save you time, money, and trouble? Ask him, too, about the Betz *Specialized* Water Conditioning Service.

W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1, Canada.

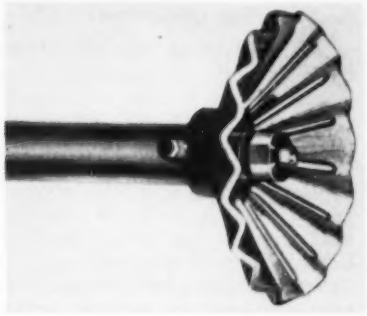
For complete information on the Dianodic method, write today for Betz Technical Paper No. 125.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

it can be open, closed or sealed tight under vacuum or pressure. A cast-iron base plate with integral clamp is included with each stirrer, making possible a wide variety of positions and tilts, on stands or on "Flexaframe" units, although other clamps may already be in place. The entire unit consists of a stirring unit, support plate with clamp, two stirring bars, one sealed in glass, one in polyethylene. Power is 115 volt 50/60 cycle AC. Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Circle No. **13** *on Reply Card*



Illium-G Burner Tips Last 10 Times Longer

. . . than steel, the manufacturer states. These results have been obtained, it is said, after years of actual field use. In one sludge-burning application at a refinery, Illium tips are said to have stood up for three months where various steel tips failed in several hours to three or four days. Composition of tips is a high chrome-nickel alloy, and they are provided by the company in many shapes and designs. Illium Corp., Freeport, Ill.

Circle No. **14** *on Reply Card*

New Gasoline-Soluble Dye Produces Red-Orange Shade

. . . or bronze color in one operation. Use of duPont "Oil Bronze," it is said, will simplify operations for refiners who have previously obtained these shades by addition of several dyes. The material is uniform in shade strength and physical condition, and is said to have a high solubility in gasoline. It is not extracted with distilled water, sea water or 0.1N caustic solution. The material can be handled by any standard method of dye addition including dry dye eductor systems. Petroleum Chemicals Division, E. I. duPont de-Nemours & Co., Wilmington 98, Del.

Circle No. **15** *on Reply Card*

To meet price and performance specifications

ORONITE LUBE OIL ADDITIVES

are tailor-made to your base oils

Why not talk over your problem with us?

You will find Oronite Additives offer important savings in treating costs because of the high quality detergent and inhibitor chemicals from which they are made. Oronite's standards are rigidly high so you can be sure of uniformity in your finished oil.

An additive specialist will call on you on request. Phone or write the Oronite office nearest you.

ORONITE CHEMICAL COMPANY

THE NAME TO WATCH IN CHEMICALS

With Oronite Additives you can formulate oils to meet the new A. P. I. Service Classifications and can meet specifications for 2-104-B, MIL-O-2104, Supplement 1 and Series 3 oils.

ORONITE CHEMICAL COMPANY

38 SANSOME STREET, SAN FRANCISCO 4, CALIF.
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
STANDARD OIL BLDG., LOS ANGELES 15, CALIF.
600 S. MICHIGAN AVENUE, CHICAGO 5, ILL.
MERCANTILE SECURITIES BLDG., DALLAS 1, TEXAS

J-M BLAZECRETE cuts refractory maintenance costs...

That's why it pays you to use this hydraulic-setting refractory for temperatures to 3000F

Blazecrete* materially reduces labor costs for refractory maintenance. This hydraulic-setting refractory saves time in building and repairing linings for high-temperature equipment.

For troweling, just mix Blazecrete with water as you'd mix ordinary concrete . . . then slap-trowel it in place. When gunned, it adheres readily with a minimum of rebound loss. Either way, Blazecrete goes on fast, without laborious ramming or tamping. And Blazecrete linings *last.*

Three types of hydraulic-setting Blazecrete are available. All harden on air curing, do not require prefiring. They are furnished as a dry mix—can be stored safely for use as needed.

3X BLAZECRETE—For temperatures through 3000F. Unusually effective for heavy patching, especially where brickwork is spalled or deeply eroded. Excellent for forge furnace linings, lime kilns, burner blocks, soaking pits, and industrial boilers.

STANDARD BLAZECRETE—For temperatures through 2400F. Makes repair work easier and less costly. Can be used by boiler manufacturers to replace fire clay tile in wall construction. Suitable for use in combination with 3X Blazecrete and L. W. Blazecrete.

L. W. BLAZECRETE—For temperatures through 2000F. An insulating refractory . . . light in weight, low in thermal conductivity. Adaptable and economical for many other applications.

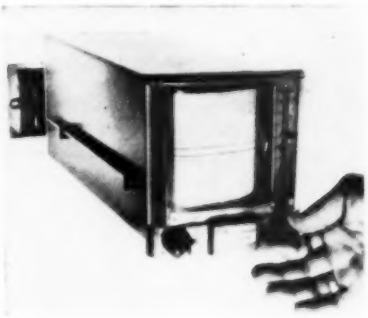
Send for Brochure RC-28A on Blazecrete and its companion material, Firecrete*. . . the hydraulic-setting castable refractory for making special shapes and linings. Write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ontario.

*Reg. U.S. Pat. Off.

Whether you gun it... *or slap-trowel it...*

Johns-Manville **BLAZECRETE**

BUILDS BETTER REFRACTORY LININGS



Miniature Recorder Can Receive Four Variables

. . . instead of the conventional three. Pneumatically operated "Ratographic Recorder" is said to be capable of recording two variables and indicating two more, or recording three variables and indicating the fourth. It can be used in standard, graphic or semi-graphic panel mounting. To transform the instrument into a recording-controller with the advantages of a loading station, a standard F&P field-mounted pneumatic controller may be plugged into the back of the recorder chassis. The resulting apparatus can, for instance, record signals from both a wild and controlled line and indicate both set point signal and valve signal. Set point indication is regulated by a true pneumatic signal tapped from the set point pressure regulator line to the controller. Fischer & Porter Co., 13 Jacksonville Rd., Hatboro, Pa.

Circle No. **16** *on Reply Card*

Adhesive Developed for Binding Teflon to Itself or to Metal

. . . and a variety of other materials. Of the pressure-sensitive type, the new adhesive is said to have good acid and alkali resistance and electrical properties. Tests have indicated a peel strength of over 1000 gms./inch or a direct pull of 12 to 15 psi. for Teflon to Teflon and Teflon to stainless steel. The material, "Flexrock No. 80," can be applied by brushing, dipping or spraying. For small applications, brushing is reported to be adequate. Air drying is satisfactory but takes several hours, and this period can be reduced by heating for 15 to 30 minutes at about 210° F. Heating for 5 minutes at 300° F. will result in greater adhesive strength. Flexrock Co., Packing Div., 3602-T Filbert St., Philadelphia 1, Penna.

Circle No. **17** *on Reply Card*

(To obtain more data on advertised products see page 1936)

Cancer strikes one in five

Strike back

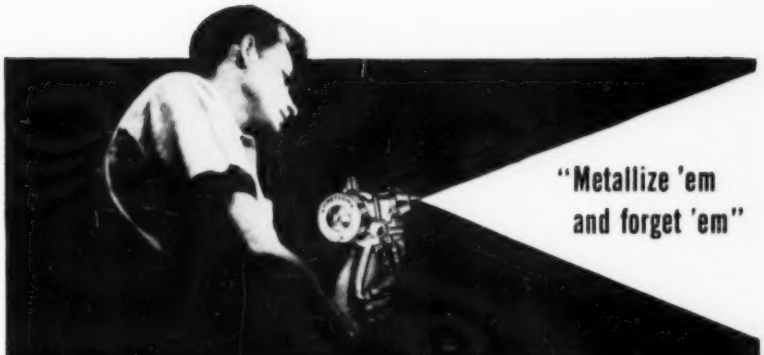
By saving lives, by easing pain, by improving services to cancer patients, by supporting research that will find the final answers to cancer . . .

That is how your dollars strike back at cancer when you give them to the American Cancer Society.

Send your gift today by mailing it to "Cancer" care of your local post office.

Give to conquer cancer

American Cancer Society



want to forget about rust for 20 years?

Pure zinc or aluminum, molten-sprayed on iron or steel surfaces, provides complete, dependable protection against atmospheric corrosion for upwards of 20 years without further maintenance. Such coatings are *mechanically* bonded to the surface—adhesion is *not* dependent on volatile vehicles or binders. Scaling, crazing, blisters, are eliminated. Protection is positive. "Metallize 'em and forget 'em!"

Why not find out more about how you can forget rust for 20 years or more? For descriptive Bulletin 62B—or the name of your nearest Metco Systems contractor—write or wire.

**Reg. U.S. Pat. Off.*

the Metco* Systems

—a series of 18 basic engineering specifications developed over 19 years of experience with pure zinc and aluminum coatings on many different types of structures and equipment. The *Metco Systems* provide for standardization of surface preparation, metal coating thicknesses and organic aftercoatings for various service conditions and appearance requirements.

Metco Systems Dept. PP, 38-14 30th Street Long Island City 1, New York

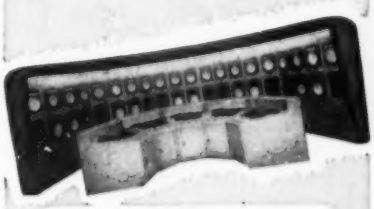
Just off the press!

NEW FALSTROM BULLETIN 142 . . .

This new engineer-designer file folder is a complete guide to custom built metal parts of steel, aluminum and other alloys. Includes instrument panels, aluminum cabinets, control cubicles and chassis frames.

Write **FALSTROM** *today!* **for your copy**

FINE INSTRUMENTS *deserve* **FINE PANELS**



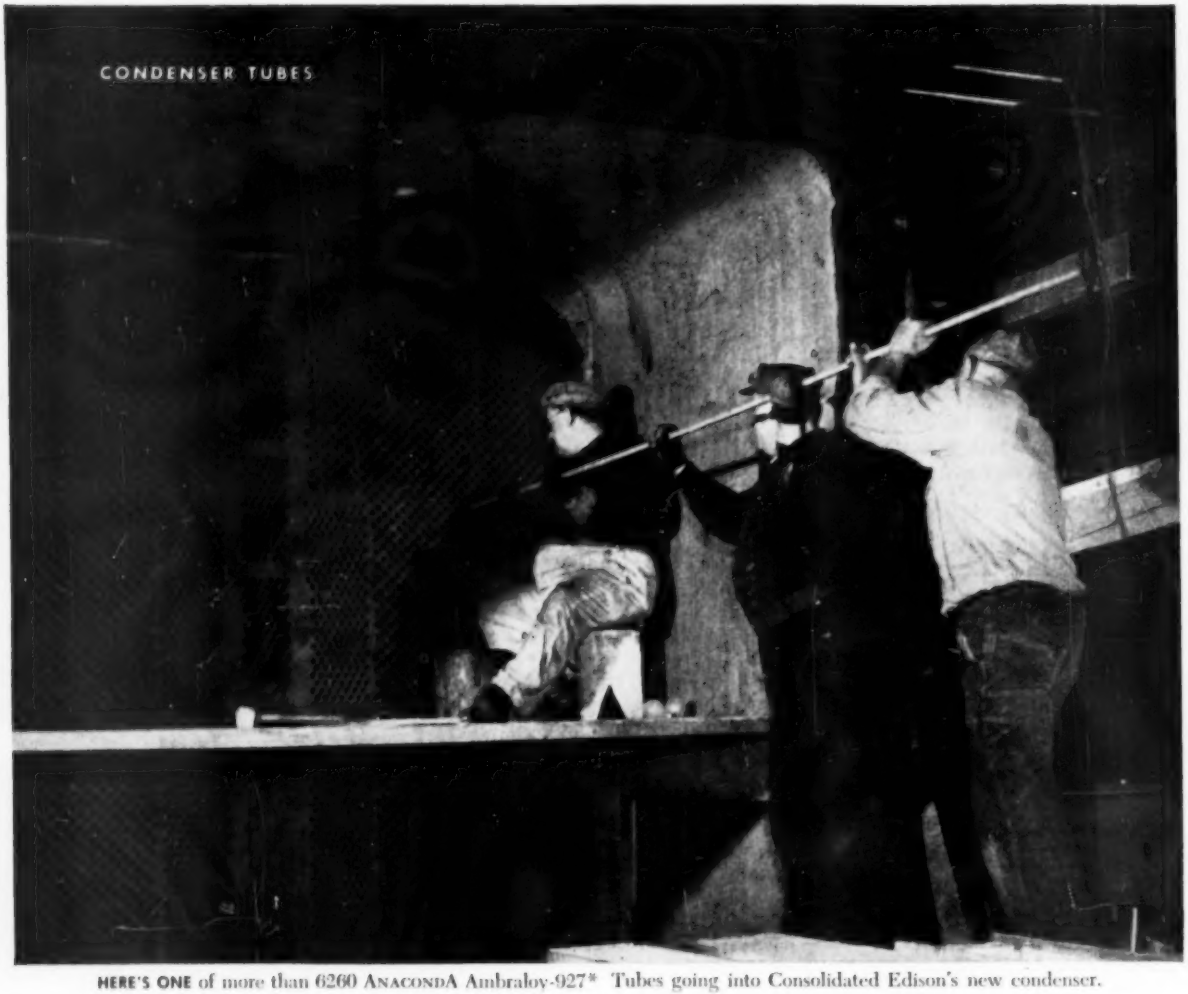
. . . like the admirable Falstrom CONTROL CENTER shown here! This is indeed the last word in modern instrumentation—suited to the finest and newest petroleum cracking plants or power installations.

. . . yes, nothing but an actual visit to this western control station can convey the sense of its sweeping beauty and painstaking construction.

FALSTROM COMPANY

59 Falstrom Court, Passaic, New Jersey

ENGINEERS • DESIGNERS • FABRICATORS SINCE 1870



HERE'S ONE of more than 6260 ANACONDA Ambraloy-927* Tubes going into Consolidated Edison's new condenser.

Con Edison chooses Aluminum Brass for condenser tubes in new power plant

The Consolidated Edison Company's new power plant in Astoria, N. Y., will house 6 generating units. Unit #2, having a 160,000-kw generator, will be put on the line in the Spring of 1954. The condenser serving this unit has cooling surface area of 105,000 sq. ft. Tubes—15,450 of them—are Aluminum Brass, ¾" O.D., #18BWG, 30 ft. long. About half were supplied by Anaconda.

LOCATED IN ASTORIA, QUEENS, on the East River, Con Edison's new plant will mean better-than-ever electrical service for New York City.

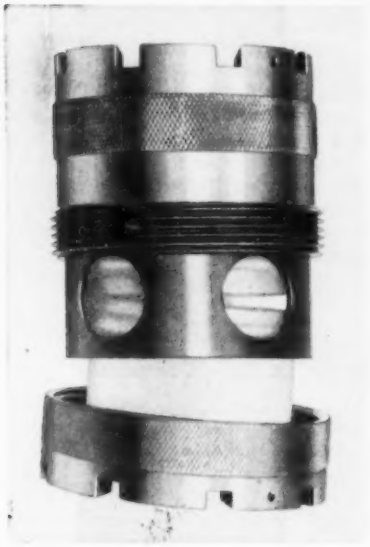
ANACONDA Ambraloy-927* (aluminum brass) is one of the most durable tube alloys available at a moderate cost. It gives excellent service in both clean and polluted sea water and has largely replaced Admiralty along the U. S. seacoast. It is used not only in main condensers, but also in auxiliary coolers for lubricating oil, transformer oil, hydrogen and air.

Anaconda supplies Con Edison — which insists upon the best equipment available — with condenser tubes and tube sheets for many of their power plants. Whatever alloy best fits *your* operating needs, choose it from the extensive line of ANACONDA Alloys for tube and tube sheets. Our Technical Department will be glad to analyze your tube performance problems at no cost. Free Publication B-2, "ANACONDA Tubes and Plates for Condensers and Heat Exchangers," will be sent on request. Write: *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.* 53112

*U.S. Patent No. 2,063,585 (ORIG.)

ANACONDA®

Tubes and plates for condensers and heat exchangers • welding rods • American Flexible Metal Hose and Tubing • American Vibration Eliminators



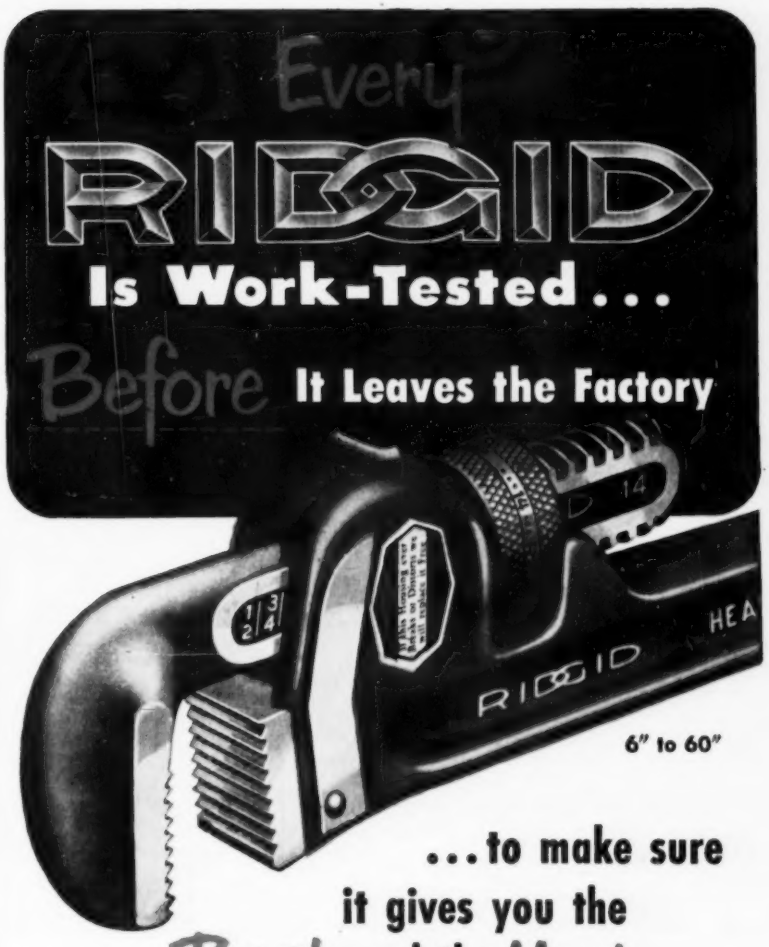
Flexible Coupling Assembly Reduces Weight by 80%

. . . over standard connections, it is said. "Wig-O-Flex" coupling is now being used primarily in aircraft, where lightness is an important factor, but the manufacturer says the units offer increased operational efficiency on any equipment where gas or liquid is transferred. The union is said to handle a misalignment up to 1/6-in., tube separation to ¼-in., and allows at least 4° tube flexure. It cannot blow apart because its design provides metallic retention of tube ends. Unit functions either as a slip joint or packing gland. It assembles on standard tube beads, and requires standard O-rings, both in size and materials. Tests have shown it to be leak-proof at three times the pressures encountered in current jet aircraft. Tight seal is maintained in temperatures ranging from —65° F. to 600 F. Units are obtainable in sizes from 1-in. to 4-in. E. B. Wiggins Oil Tool Co., 3424 E. Olympic Blvd., Los Angeles 23, Calif.

Circle No. **18** *on Reply Card*

Explosion-Proof Hand Lamp Has Non-Metallic Housing

. . . and weighs only 4¾-lb. Only the globe guard, globe holder and cord connector housing of the unit are aluminum. The lamp receptacle housing, also aluminum on earlier models, has been replaced by a molded phenolic composition. The new unit is said to have much higher impact-resisting qualities. Both lamp chamber and handle are explosion-proof, separated by the lamp receptacle. Flame-tight joints located along the globe holder,

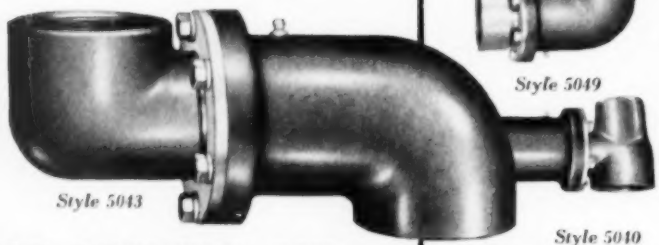


The reason RIDGID Heavy-Duty Pipe Wrenches are known for the brutal punishment they can take is because of the toughness built into them, checked part by part and then hard work-tested when assembled . . . not just one wrench in 100 or 1000 but *every last one!* . . . Add the guaranteed repair-free housing, no-slip no-lock jaws, handy pipe scale, easy spinning adjustment nut and comfort-grip I-beam handle and you see why genuine RIDGID gives you the big value for your money. Buy them at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO

BARCO

SWING JOINTS



FOR LOADING AND UNLOADING LINES

BARCO'S new, attractively priced, all-steel ball bearing *Swing Joints* are designed specifically for refinery *service* on loading or unloading lines handling gasoline, oil, lube oil, LP gas, petro-chemicals, and other fluids.

MANY STYLES—The Barco line is complete with single swing, double swing, and counterbalance styles to meet every need! Sizes 2", 2½", 3", 4".

BALL BEARING AND O-RING EQUIPPED—In Barco Swing Joints, the ball bearings do not fall out when joints are taken apart! Long bearing provides adequate pipe support. *Special O-ring seal eliminates frequent gasket replacement and insures leakproof service* over wide temperature range, −40° F. to +225° F.

SIMPLE CONSTRUCTION—Joints can be disassembled for inspection without disconnecting piping. O-rings are easily renewable in the field.

ENGINEERING RECOMMENDATION—Barco will be glad to give you detailed recommendations on joints to use and suggested arrangements for complete loading and unloading assemblies.

Send for a copy of new Catalog No. 400 containing complete information on Barco Swing Joints. BARCO MANUFACTURING CO., 559N Hough St., Barrington, Ill.

(A Chicago Suburb)

BARCO—The Only Truly Complete Line of Flexible Ball, Swivel, Swing, and Revolving Joints

handle and cord connector prevent an explosion in one compartment from being transmitted into the other. These joints have five or more full-threaded turns, that, after an explosion, allow only cooled gases to escape. Pressure type wire connectors are used to minimize danger of wires being pulled free under strain of continuous wear. Crouse-Hinds Co., 7 North St., Syracuse. N. Y.

Circle No. **19** *on Reply Card*

Trade Literature

Biuret, A New Compound

. . . similar to urea and usable in applications where urea or melamine is now used; *Product Bulletin PD-B-1* says the new material is available in experimental quantities, and is not intended specifically as a substitute for urea or melamine but as an additional material where its properties prove valuable; included are physical and chemical properties, reactions and literature references. Nitrogen Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

Circle No. **20** *on Reply Card*

Scale Prevention

. . . through the use of the company's water and fluid conditioners; 4-page leaflet gives several typical problems in the oil industry, and shows how the manufacturer's equipment has solved them. Evis Mfg. Co., 40 Boardman Place, San Francisco, Calif.

Circle No. **21** *on Reply Card*

Insulations and Refractories

. . . for the process industries; many other types of protective materials and corrosion-resistant piping and fittings described in 8-page catalog. Johns-Manville, 22 E. 40th St., New York 16, N. Y.

Circle No. **22** *on Reply Card*

Float and Lever Valves

. . . for many types of installation; 16-page *Catalog* 107 illustrates and gives size and pressure specifications on the manufacturer's product line. Schade Valve Mfg. Co., 2527-2537 N. Bodine St., Philadelphia 33, Pa.

Circle No. **23** *on Reply Card*

Electronic Flow Meter

. . . and other instruments, briefly listed in company's 4-page *Bulletin* 52-1074-222. Hays Corp., Michigan City, Ind.

Circle No. **24** *on Reply Card*

Announcing Foster Wheeler's new

MOUNTAINTOP PLANT...

completely tooled to effectively meet your most exacting needs for steam generators, heat-transfer and process equipment!

ANTICIPATING your requirements for more efficient central station, industrial and process components, Foster Wheeler has installed in this new plant, near Wilkes-Barre, Pa., the latest, most modern equipment, such as: the 3000-ton beam press, 2 million volt x-ray facilities, the newest developments in submerged arc-welding and high-speed drilling equipment, 83½ foot long stress-relieving furnace and others shown here.

This modern equipment, the plant's proximity to steel supplies, and its strategic location for direct rail shipment to all areas, assure you of fast, economical, high-quality fabrication to meet your specifications for the largest, heaviest drums and pressure vessels.

1. 8000-TON BEAM PRESS
Hydraulically operated, will bend steel plates 40′ long, 8″ thick.

2. PLATE EDGE PLANER
Will take the longest available plates, for cutting welding grooves.

3. OVERHEAD CRANES
Four large cranes capable of lifting the heaviest and largest equipment easily.

4. DOUBLE HOUSING PLANER
Highest speed planing.

5. AUTOMATIC WELDING MACHINES
Submerged-arc, automatic flux recovery-type, mounted on track.

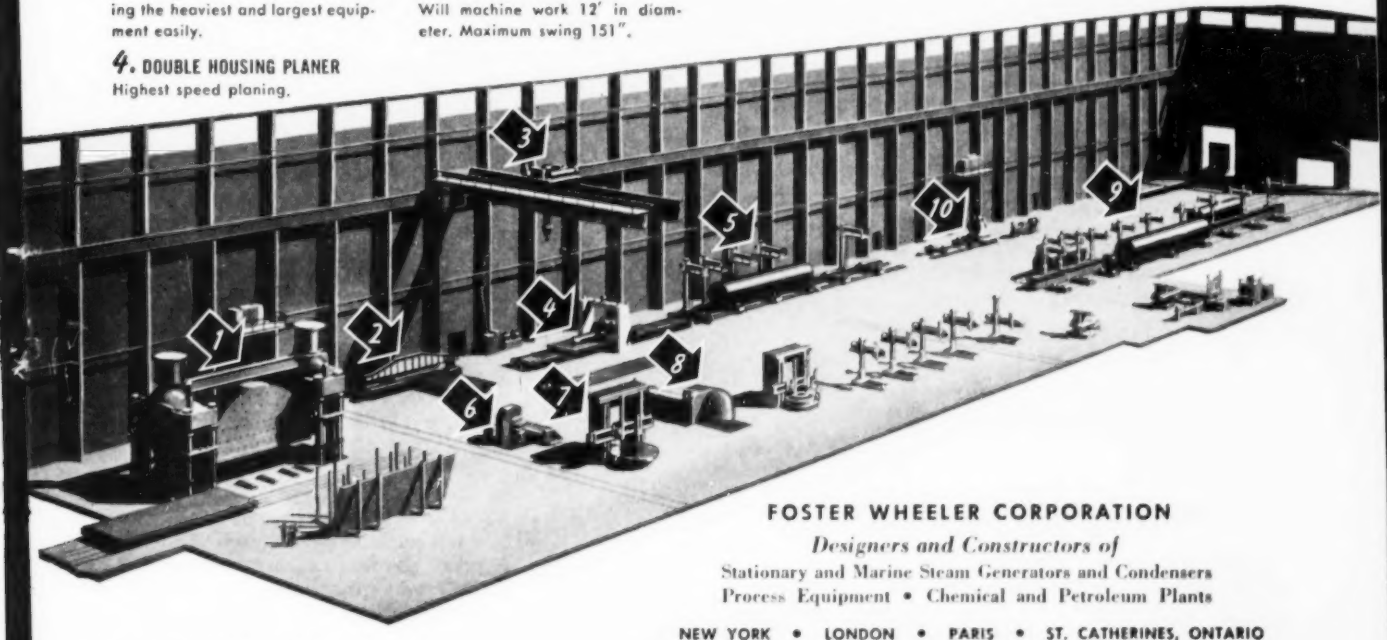
6. 500-TON CRIMPING PRESS
For cold-bending edge of plate preparatory to rolling.

7. VERTICAL BORING MILL
Will machine work 12′ in diameter. Maximum swing 151″.

8. BENDING ROLLS – PINCH TYPE
By hot or cold rolling will form cylinders for medium-pressure vessels.

9. HIGHEST SPEED DRILLS – RADIAL TYPE
These are mounted on ways and tracks, power positioned.

10. DRUM FACING MACHINE
Quick preparation of ends of cylinder for assembly with heads.



Artist's sketch of the main bay of the new Mountaintop, Pa. plant, 800′ long, 90′ wide, 75′ high.

FOSTER WHEELER CORPORATION

Designers and Constructors of
Stationary and Marine Steam Generators and Condensers
Process Equipment • Chemical and Petroleum Plants

NEW YORK • LONDON • PARIS • ST. CATHERINES, ONTARIO

FOSTER WHEELER

WHY INSULATE YOUR CONDENSER TUBES?

You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE

regardless of the source. Chlorination helps reduce slime in process or cooling water.

CD-3/

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

What's New!

Water Sampling

. . . in a power house; 4-page *Leaflet* 28X7969 tells which samples are important, when and where they should be taken and how they should be drawn; with diagrams. Allis-Chalmers Mfg. Co., 836 S. 70th St., Milwaukee, Wisc.

Circle No. **25** *on Reply Card*

Heat Insulation

. . . material, a chemical compound of lime and silica; product's uses and performance are analyzed in 8-page bulletin which includes table on insulation efficiency under varying temperatures. Owens-Corning Fiberglas Corp., Nicholas Bldg., Toledo 1, Ohio.

Circle No. **26** *on Reply Card*

Industrial Steam Traps

. . . equipped with bellows and bodies in a variety of metals and sizes; 12-page *Bulletin* 853 gives capacity tables and dimensions and pictures typical installations. W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa.

Circle No. **27** *on Reply Card*

Centrifugal Pumps

. . . specifically designed for boiler feed, refinery and process work; 18-page *Bulletin Form* 7251 contains sectional drawings, installation views and a 2-page chart showing interchangeability of parts throughout the manufacturer's line. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Circle No. **28** *on Reply Card*

Molecular Vacuum Gage

. . . to measure pressures without external detectors; 4-page *Bulletin GEC*-986 gives applications of two models available, specifications and prices, and discusses operational advantages. General Electric, Schenectady 5, N. Y.

Circle No. **29** *on Reply Card*

Temperature Controller

. . . with range extended to cover —100°-+600° F.; 12-page *Bulletin P*-811 contains complete specifications prices and application information on the unit in either of two models. Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

Circle No. **30** *on Reply Card*

What's New!

Engineering and Construction

. . . facilities of one of the country's well-known engineering firms; 24-page brochure contains descriptive material and illustrations on what the company has done and hopes to do. The Fluor Corp., 2500 S. Atlantic Blvd., Los Angeles 22, Calif.

Circle No **31** *on Reply Card*

Instrument and Control

. . . boards; 8-page *Bulletin* 700 illustrates the company's different types of units, shows varying methods of installation and describes components briefly. Continental Electric Equipment Co., Box 1055, Cincinnati 1, Ohio.

Circle No. **32** *on Reply Card*

High Vacuum Apparatus

. . . and system planning; a description of the manufacturer's products and services, with illustrations and specifications on each item; prices, too, in 60-page *Bulletin* 10*F*. Central Scientific Co., 1700 Irving Park Rd., Chicago 13, Ill.

Circle No. **33** *on Reply Card*

Tubing Steels

. . . used in high-temperature or high-pressure service; technical information on 14 types, including analyses, mechanical and physical properties, creep strength, oxidation resistance, etc.; in 6-page *Folder TDC* 163. Babcock & Wilcox Co., Beaver Falls, Pa.

Circle No. **34** *on Reply Card*

Pneumatic Signal Transmitter

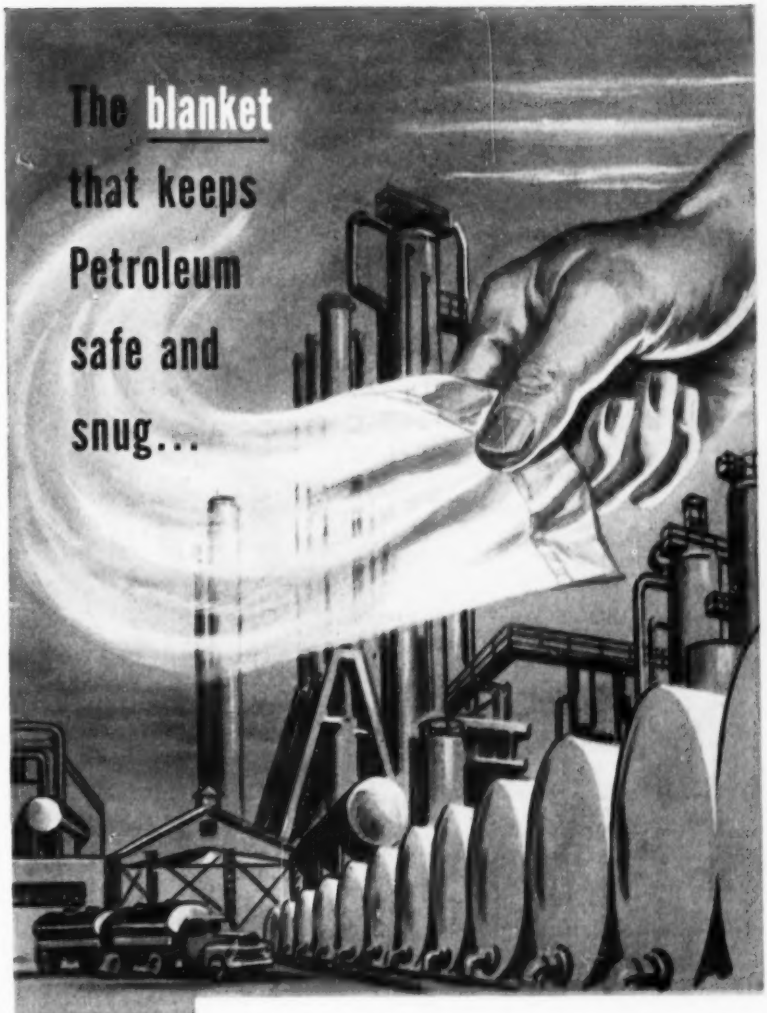
. . . for use in measuring, indicating and controlling fluid flow and liquid level at operating pressures up to 1500 psi and pressure differentials up to 100 psi for steam generation and process control; construction details and operational advantages outlined in 8-page *Bulletin* 2553. Hagan Corp., Hagan Bldg., Pittsburgh 30, Pa.

Circle No. **35** *on Reply Card*

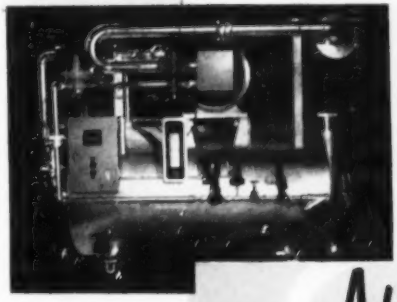
Diaphragm Control Valve

. . . specifications; 4-page *Bulletin SP-CV*1 discusses requirements for topworks, body, trim, valve positioners, packing and special bonnets and inspection techniques. Delaware Valley Engineering Co., 3326 Lancaster Ave., Philadelphia 4, Pa.

Circle No. **36** *on Reply Card*



● The processing of petroleum, paint and varnish and like products where volatile fumes are present used to be a dangerous job. Today, this danger has been minimized through the use of the inert gas blanket that holds oxygen away from the fumes, preventing the combustible mixture that made this work hazardous.



Compact in design the Gas Atmospheres Inert Gas generator is available in a complete size range to produce any volume of gas required.

Modern gas generation equipment has made it possible for even the small processing plants to obtain this inert blanket protection at unbelievably low cost. If you are buying gas, or manufacturing it by old obsolete methods, it will pay you to drop a card to Gas Atmospheres, Inc., today.

gas Atmospheres, inc

equipment for producing industrial gases

20011 WEST LAKE ROAD CLEVELAND 16, OHIO

A LEE WILSON ENTERPRISE

G-R...
from every
point of view...
top value in

Air-Cooled Heat Exchangers

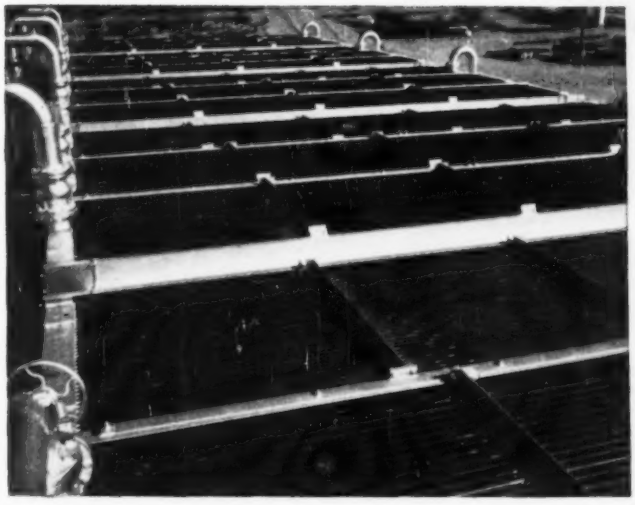
There's a mighty good reason why the G-R **fin-fan** is top value in air-cooled heat exchangers.

The reason is the experience behind this unit. This experience includes 85 years of building heat transfer apparatus, 25 years of experience in specializing on extended heat transfer surfaces as used in air-cooled exchangers, the operating records of hundreds of **fin-fan** installations all over the world, and the results of tests on the cooling sections, drive mechanism and structure that combine to form the G-R **fin-fan** air-cooled exchanger.

For assurance of best results from an air-cooled exchanger, investigate G-R **fin-fan**.

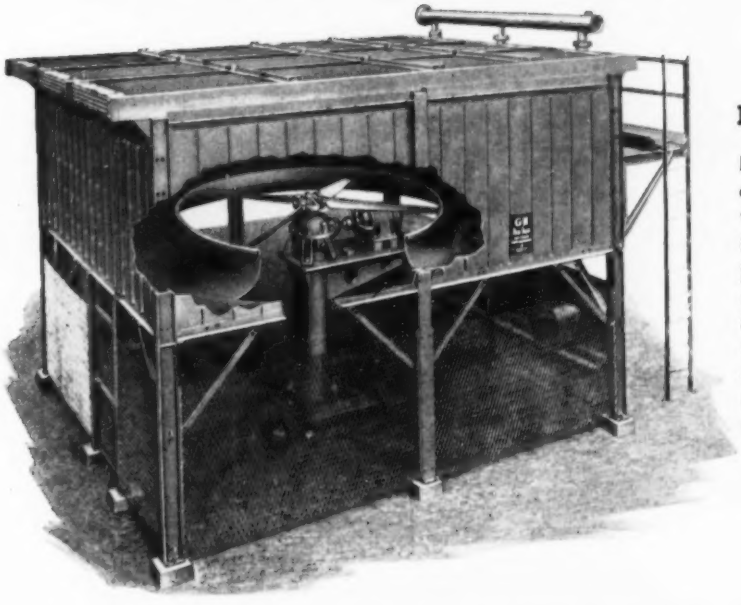
THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

G-R HEAT TRANSFER APPARATUS **fin-fan** Air-Cooled Heat Exchanger



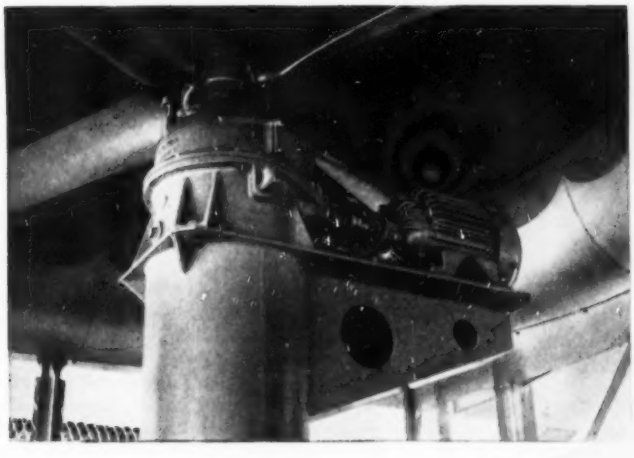
FROM ABOVE

This is a view of the K-Fin Sections which form the heat transfer surface used only in the G-R **fin-fan.** Many millions of square feet of this exclusive helically-finned surface are being used in more types of air-cooled services than any other design . . . one of the reasons for their dependable ratings as well as their dependable design and construction.



FROM THE SIDE

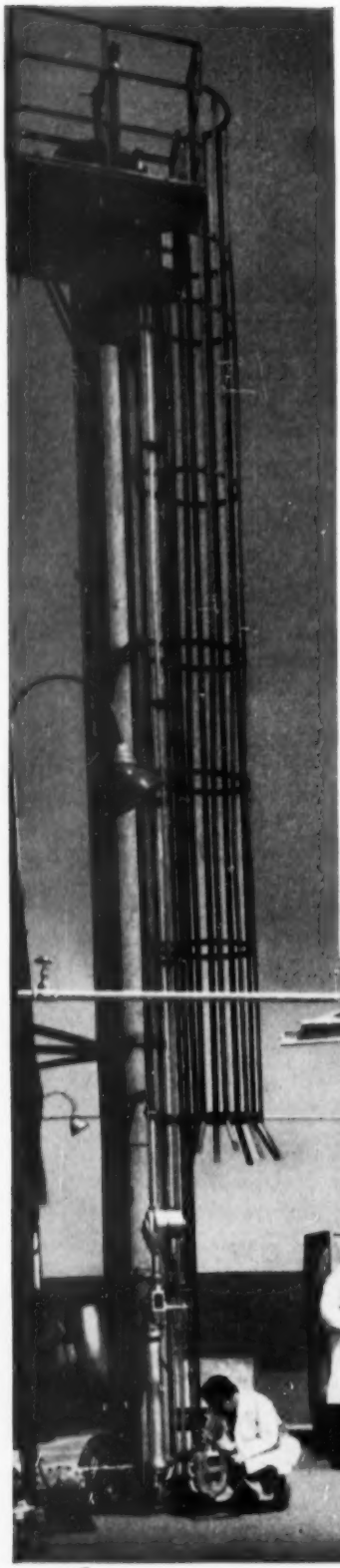
Here you see the strong reinforced construction that is built to withstand wind pressures of more than 40 lbs. per sq. ft. . . . the pre-fabricated, pre-drilled structure that is specifically designed for speed and convenience of erection and connection to additional units . . . the slope of the K-Fin Sections to assure drainage . . . and the protecting fence which completely surrounds the unit.



FROM BELOW

You are looking at a typical drive mechanism for G-R **fin-fan.** Note the mounting of driving motor and gear reducers . . . one of many alternative arrangements . . . the powerful fan of proven performance, and the smooth bell ring for maximum aerodynamic efficiency.

GR384

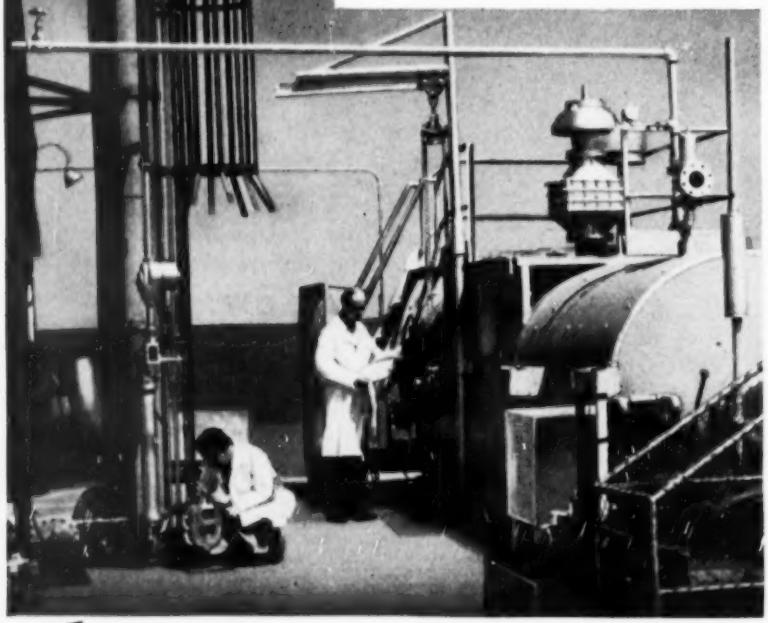


"Varec" meets the Challenge of Obsolescence!

The PETRO-CHEMICAL INDUSTRY is a dynamic one—continuously changing and constantly expanding to boost output and produce better products. This creates a high rate of obsolescence that demands new equipment designs and new material applications for replacements.

Vapor Recovery Systems Company is timing its production to meet this demand. Our Engineering department is continually testing new and better designs, seeking the finer quality parts, and adopting the most corrosive-resistant materials available to contribute to the progress of industry.

Whether you are installing or improving your TANK EQUIPMENT—GAS CONTROL DEVICES—GAUGING SYSTEMS, you'll find the "VAREC" line prepared to do the job in a better way.



"Varec" PROVED — APPROVED

THE VAPOR RECOVERY SYSTEMS COMPANY
2820 NORTH ALAMEDA STREET • COMPTON, CALIFORNIA
Manufacturers of "VAREC" Equipment
Representatives in Principal Cities of the World

What's New!

Television in Industrial

. . . applications; 4-page *Bulletin* 1025-*A* shows how the manufacturer's "Utiliscope" works, describes its parts and tells what advantages it has in centralizing control and avoiding hazardous operational situations. Diamond Power Specialty Corp., Lancaster, Ohio.

Circle No. **37** *on Reply Card*

Heat Transfer Equipment

. . . including engine jacket water coolers, combination cooling units, supercharger air intercoolers, evaporative coolers and many others; each item pictured and briefly described in 4-page *Catalog* 353. Young Radiator Co., Racine, Wisc.

Circle No. **38** *on Reply Card*

Differential Transmitter

. . . with non-bleed pilot relay; 4-page *Bulletin* 2290 shows construction features, specifications and applications of pneumatic force-balance unit for measuring and transmitting flow and differential pressure. Hagan Corp., Pittsburgh 30, Pa.

Circle No. **39** *on Reply Card*

Electronic Timer

. . . for viscosity measurement and other timing requirements; instrument described and specifications given in single page data sheet. Hallikainen Instruments, 1341 7th Ave., Berkeley, Calif.

Circle No. **40** *on Reply Card*

Steam Generators

. . . and allied equipment; 20-page *Bulletin G.B.*-153 describes eight basic arrangements of two, three and four drum steam generators to meet a wide range of loads, pressures and temperatures for power, process and space heating; data on other of the manufacturer's process equipment items included. Union Iron Works, Erie, Pa.

Circle No. **41** *on Reply Card*

Propeller Fans

. . . and their applications; 44-page *Bulletin-A*-109 shows three new models among the 13 types discussed, giving specifications, dimensions and performance figures, as well as a discussion of corrosion-resistant materials and coatings for use on fans in special installations. Hartzell Propeller Fan Co., Piqua, Ohio.

Circle No. **42** *on Reply Card*

This Way

TO SOLVE YOUR **HIGH-TEMPERATURE** PROBLEM

HIGH TEMPERATURE WORK SHEET
A simplified form to describe your material problem for study and suggestions
THE INTERNATIONAL NICKEL COMPANY, INC.
DEVELOPMENT and RESEARCH DIVISION
67 Wall Street - New York 5, N. Y.

Perhaps you no longer need to put up with the repeated troubles and expense that high temperatures can cause.

With this "Work Sheet" you can quickly give INCO's High Temperature Engineering Service the direction to search out whether an INCO Nickel Alloy or another material is a practical way to solve your problem.

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Please send me the High-Temperature Work Sheet.

Name _____ Title _____

Company _____

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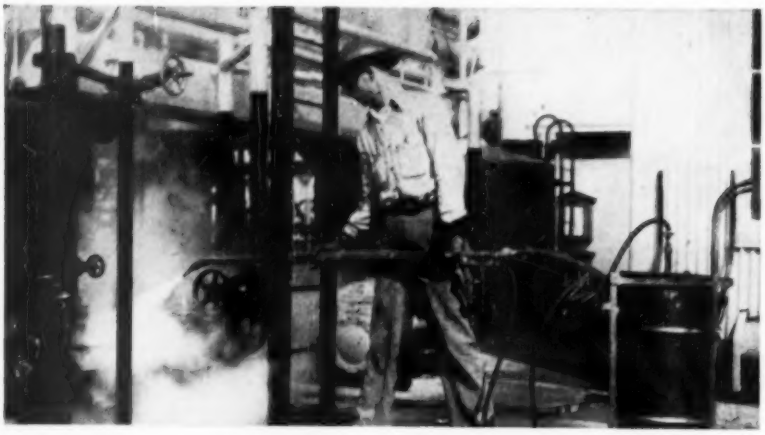


Cleaning time cut from days to hours at Western refinery

Oakite Steam-Detergent Gun makes short work of cleaning before repainting

The cleaning problem facing this California refinery was simple enough: removing dirt, grease, muck from tanks, pumps, and other equipment. But it meant tedious scraping, wire-brushing, wiping by a sizable crew, and a lot of areas where manual cleaning couldn't reach. Did the Oakite Man have a better answer?

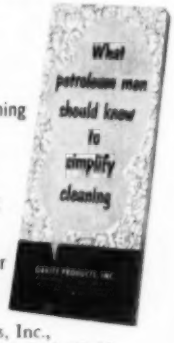
He did—as a result of his wide refinery experience. He suggested the Oakite 384 Steam Gun. He helped the crew get started that morning. By afternoon, the plant superintendent stated, "One man did about two weeks' work today".

Proving that—in industrial cleaning it always pays to consult Oakite.

Call your Oakite Technical Service Representative. His experience is yours to draw on. He'll study your cleaning problem, suggest and demonstrate the best material and method. He'll keep checking back to see that you get top quality cleaning at low cost. Call him today!

FREE HANDBOOK—
full of facts on

- Drum reconditioning
- Descaling
- Cleaning tanks
- Salvage cleaning
- Paint stripping
- Cleaning tank car interiors



Write Oakite Products, Inc.,
50D Rector St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE petroleum service division
Technical Service MATERIALS • METHODS • SERVICE Representatives in Principal Cities of U. S. and Canada

—WANTED—TECHNICAL WRITER—

We need a technically-trained man, under 30, for the editorial staff of PETROLEUM PROCESSING. He should have a background of mechanical engineering and experience in refining or petrochemical manufacturing operations—with emphasis on equipment. He should be able to write clearly and cleanly, and have done some work in preparing reports.

He should have an inquisitive mind and like to probe into the "why" of things, and be able to explain to others what he has found out.

Experience in magazine or newspaper production is desirable but not essential.

Duties will include editing and rewriting copy, with responsibility for specific departments in the magazine, and field trips to gather data for original articles. Location is in New York City, and salary is open. Send details to:

EDITOR, PETROLEUM PROCESSING
1213 West Third Street • Cleveland 13, Ohio

What's New!

Water Treating

. . . by demineralizing; 39-page *Bulletin* 5800 explains the principles of ion exchange and outlines design and operation of multi-stage and mixed bed demineralizing systems, with operating results and flow diagrams of several existing plants included. Cochrane Corp., 17th St., Philadelphia 32, Pa.

Circle No. **43** *on Reply Card*

Protective Coatings

. . . for tank linings, severe corrosive service and general protective service; coatings for each purpose described in detail with performance data and application techniques discussed in 8-page bulletin. Nukem Products Corp., Buffalo 20, N. Y.

Circle No. **44** *on Reply Card*

Electronic Controllers

. . . of the indicating and recording type; for temperature, pressure, flow and other variables; 16-page *Bulletin B*226 illustrates each piece of equipment, gives specifications and discusses usages. The Bristol Co., Waterbury 20, Conn.

Circle No. **45** *on Reply Card*

Centrifugal Pumps

. . . of two, three and four stage types for heads up to 650 psi and with capacities of from 50 to 850 gpm; 8-page *Bulletin* 237-*C* describes and illustrates the various items, tells where they can best be used. Pennsylvania Pump and Compressor Co., Easton, Pa.

Circle No. **46** *on Reply Card*

Motor Starters

. . . of the manufacturer's Type H, built to control squirrel-cage, synchronous, wound rotor and multi-speed motors in ratings from 2200 to 5000 volts; described in 12-page bulletin. Allis-Chalmers Mfg. Co., 836 S. 70th St., Milwaukee, Wisc.

Circle No. **47** *on Reply Card*

Sine Potentiometer

. . . and 14 linear potentiometers in the manufacturer's "Servocalculator"; *Laboratory Report No.* 7 describes the theory and applications of this instrument, as well as its accuracy limitations. Technology Instrument Corp., 531 Main St., Acton, Mass.

Circle No. **48** *on Reply Card*

NATIONAL AIROIL FUEL OIL - GAS BURNERS

SERVING INDUSTRY FOR 41 YEARS

- Steam Atomizing Oil Burners
- Mechanical Atomizing Oil Burners
- Low Air Pressure Oil Burners
- Rotary Oil Burners
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- Combination Gas and Oil Burners
- Tandem Block Combustion Units
- Fuel Oil Pump Sets
- Refractory Burner and Muffle Blocks
- Valves, Strainers, Furnace Windows

Detailed Information gladly sent you upon request.

Established 1912 — Incorporated 1917

NATIONAL AIROIL BURNER COMPANY, INC.

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SELLERS

HYDRAULIC JET CLEANER

LEAST EXPENSIVE TO BUY & OPERATE

MOST EFFECTIVE FOR HEAVY DUTY CLEAN-UP

Operated by ordinary plant steam and cold water lines, this unit propels a solid jet of extremely high pressured hot water and detergent. The discharge force completely cleans areas up to 30 ft. from operation point, reaching inaccessible machinery parts. Eliminates down time and scaffolding. Removes all soil, sludge, and encrusted deposits.

CUTS CLEANING COSTS UP TO 94%

FOR ANY PLANT WITH 5 PSI STEAM & UPWARD

Write for literature and the name of our local distributor

SELLERS Injector CORPORATION — SINCE 1848

1600 Hamilton Street Philadelphia 30, Pa.

These new Arnold O. Beckman bulletins describe...

WHERE OXYGEN CONTROL

is vital in a wide range of manufacturing and processing operations—chemicals, metals, soaps, oils, drugs, plastics, ceramics, petroleum products and many others.

WHY OXYGEN MEASUREMENT

is the key to more efficient operation, higher quality, better uniformity, less waste and greater overall profits.

HOW OXYGEN ANALYZERS

by Arnold O. Beckman, Inc. permit greater accuracy, adaptability, and efficiency than other types because these instruments *continuously* measure process streams by a unique magnetic principle that provides *direct physical measurement of oxygen itself*—not of some secondary relationship.

SEND TODAY FOR THIS HELPFUL DATA...

BULLETIN 103: *Describes the Model G-2 Beckman Oxygen Analyzer—the instrument to use where maximum accuracy is essential. Model G-2 ranges are available for oxygen concentrations as low as 0-1000 parts per million — as high as 95-100% — or virtually any other range or combination of ranges. Bulletin 103 describes the unique magnetic operating principle used in Model G-2 Analyzers, equipment, accessories and typical applications.*

BULLETIN 108: *Describes the Model F-3 Beckman Oxygen Analyzer—the instrument designed primarily for industrial applications such as combustion control, catalyst regeneration, sulfur grinding, etc., which require an oxygen measuring range of 0-5%, 0-10%, 0-15% or higher. Bulletin 108 describes the unique magnetic operating principle used in Model F-3 Analyzers, gives equipment specifications and typical applications for this instrument.*

BULLETIN AD607: *Contains helpful charts and data on most efficient methods of controlling various combustion processes.*

BULLETIN AD608: *Outlines savings to be made with oxygen control in Cat Cracking operations, gives sampling suggestions and list of equipment.*

BULLETIN AD612: *Describes gas monitoring system for gas plants and compressor stations, shows sampling arrangement, lists equipment required.*

BULLETIN AD701: *Describes a sampling system particularly suited for Cat Cracker applications . . . includes illustration of equipment layout.*

The above informative literature will gladly be sent you free. For maximum convenience, use the coupon at right.

Arnold O. Beckman Inc.

1020 Mission St., South Pasadena 12, California

Please send Bulletins checked below:

☐ 103 ☐ 108 ☐ 607 ☐ 608 ☐ 612 ☐ 701

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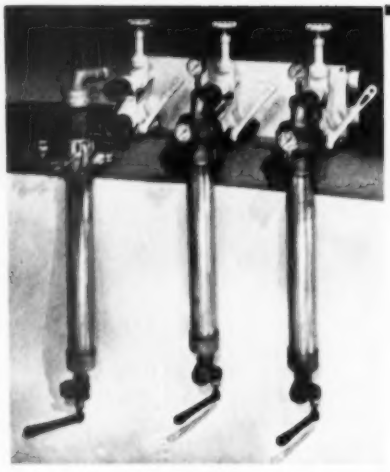

Simple and Easy

QUICK COUPLING

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Non Short-circuiting

TRIPLEX FILTER UNIT
available in
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For filtering
PROCESS WATER . . . GASOLINE
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FULL DETAILS IN BULLETIN 1152P

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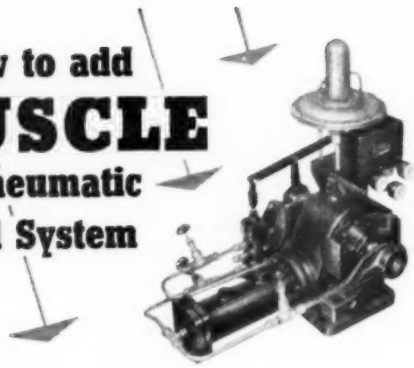
How to add
MUSCLE
to a Pneumatic Control System



Askania Pneu-Draulic Crank Cylinder gives a pneumatic control system the muscle it needs to operate large valves or dampers.

It transforms the 3-15 p.s.i. signal from a pneumatic controller into high-torque hydraulic power for positive, fast, precise positioning of butterfly valves, plug valves, or other control elements.

The Askania Pneu-Draulic Crank Cylinder is compact. Takes up less room than other types of equipment. Moreover, hydraulic operation is inexpensive.

This is one of several Askania units designed to add muscle to pneumatic control systems. Form 1-87 describes the Pneu-Draulic Crank Cylinder; Form 1-86 describes the Pneu-Draulic Slide Valve Positioner. Ask for both papers.

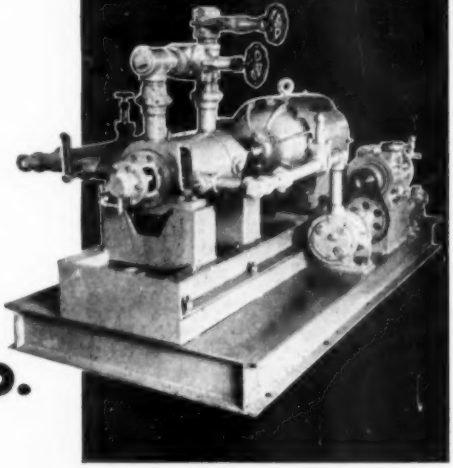
ASKANIA REGULATOR COMPANY
244 E. Ontario Street Chicago 10, Illinois
Subsidiary of General Precision Equipment Corp.

THE TURBINIZER

Here's a compact, rugged disperser that gives you complete dispersions at up to 5000 gals/hr. It operates on a principle of hydraulic shear. There are no close adjustments to be made or maintained — no contacting surfaces to wear out. Dispersion is obtained through the high speed of the dispersing rotor operating against the inertial resistance of the material being processed. Other features include controlled recirculation, pre-discharge dilution, easy cleaning and minimum maintenance.

The Turbinizer is highly versatile — handles anything pumpable including component materials of widely different viscosities. It is being extensively used for the high-speed, continuous production of limed greases, asphalt emulsions and "cut-backs," wax emulsions, cosmetic and pharmaceutical creams, lotions, and ointments, paper coatings, blended food products, and textile finishes. It can be used for blending, dissolving, dispersing, emulsifying, extracting, reacting, scrubbing, and homogenizing.

for fast, thorough dispersions or emulsions of liquids in liquids, solids in liquids, gases in liquids.



THE U. S. STONEWARE co.
PROCESS EQUIPMENT DIVISION
AKRON 9, OHIO

48rc

What's New!

Tank Car Classifications

. . . for ladings; 34-page brochure illustrates in detail manufacturer's new improvements in design, gives comprehensive tabulated information of just what type of car is needed to carry specific chemical compounds. American Car and Foundry Co., 30 Church St., New York 8, N. Y.

Circle No. **49** *on Reply Card*

Synthetic Cracking Catalyst

. . . test methods; 48-page booklet describes a group of standardized testing procedures for measuring important properties of silica-alumina synthetic fluid cracking catalyst, including determination of apparent bulk density, activity, steam stability, thermal stability, particle size distribution and others. American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N.Y.

Circle No. **50** *on Reply Card*

TEL Meter Operation

. . . and theory behind use of the manufacturer's new laboratory aid, which is said to assay TEL as accurately as the gravimetric method without requiring calibration curves of the flame-photometric methods; in 10-page *Bulletin FS-235*. Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa.

Circle No. **51** *on Reply Card*

Fluid Control Equipment

. . . of many types, including valves, pressure regulators, stainless steel cylinders, etc., illustrated and described in close detail in manufacturer's new 66-page catalog. Hoke, Inc., 161 S. Dean St., Englewood, N. J.

Circle No. **52** *on Reply Card*

Mass Spectrometer

. . . for chemical analysis by mass separation; 12-page *Bulletin GEC-587A* contains photographs and diagrams of the equipment, a description of components and explains operating procedure. General Electric, Schenectady 5, N. Y.

Circle No. **53** *on Reply Card*

Pipe Insulation

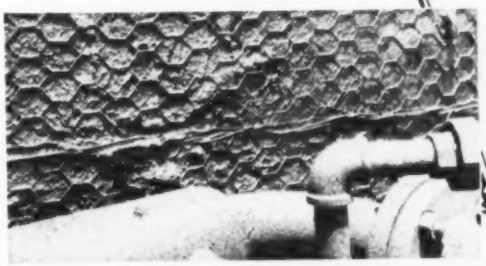
. . . composition, thermal efficiency, physical and handling characteristics of the manufacturer's product; 6-page leaflet also illustrates application techniques. Gustin-Bacon Mfg. Co., Kansas City, Mo.

Circle No. **54** *on Reply Card*

Now — fast insulation protection

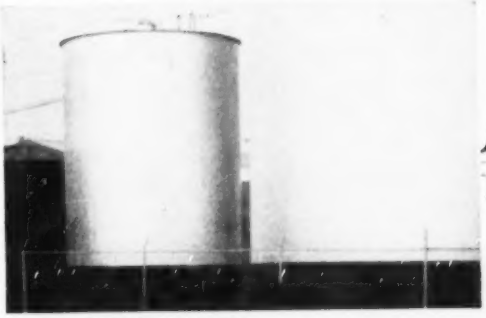
Laykold® ASPHALT SPECIALTIES WEATHERCOAT

sprays on! —in one-third the time required for troweling



• **FIRST COAT** bonds and protects wire netting.

• **SPRAY GUN** applies second coat, too, in fastest possible time.

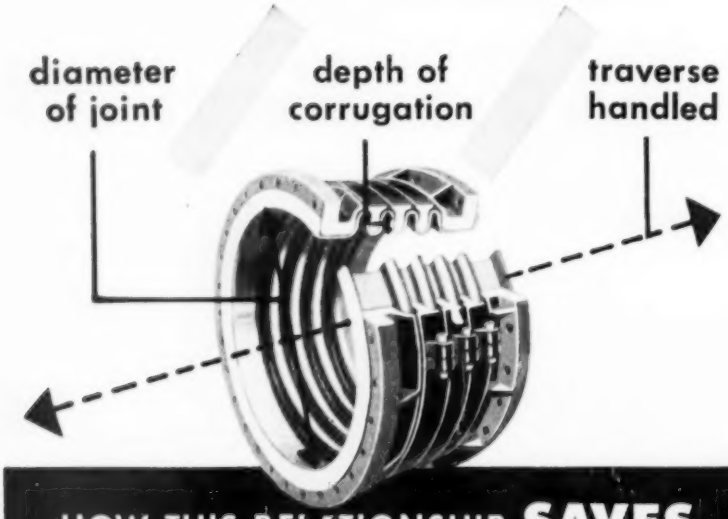


• **TRIPLE-SEALED** and smooth, after wet brooming.

WEATHERCOAT—the standard of quality in the industry —for lasting protection

AMERICAN Bitumuls & Asphalt COMPANY

200 BUSH STREET
SAN FRANCISCO 4, CALIF.



HOW THIS RELATIONSHIP **SAVES** IN EXPANSION JOINT COSTS

For each range of BADGER Expansion Joint Diameters, there is a carefully calculated depth of corrugation and a definite limit of traverse to be absorbed by this corrugation. The traverse is gauged to the depth of corrugation.

Applies equally well to welding end joints

With four different corrugation depths, there is no need either to overstress tube metal when forming the corrugation or to "over-traverse" the expansion joint installation in order to be sure of having ample capacity. The former assures longer joint life; the latter saves you in initial cost. You don't have to risk "under-traversing" the job. The joint, being just right for the job, means maximum life.

The more you study the Badger Expansion Joint—both the Self-Equalizing Directed Flexing and the Non-Equalizing Types—the more you will see and appreciate the careful engineering that has gone into these joints. And the more you study the work an expansion joint is to do, the more you will appreciate why sound engineering is a 'must' in expansion joints. You get it in Badger Joints.

BADGER MANUFACTURING COMPANY

Original and Sole Manufacturer of Badger Expansion Joints

230 BENT STREET • CAMBRIDGE • MASS.

What's New!

Gamma Radiography

. . . in industry; a listing of the protective and measuring equipment now available from the manufacturer; in stiff cardboard brochure. Technical Operations, Inc., 6 Schouler Court, Arlington 74, Mass.

Circle No. **55** *on Reply Card*

Flow Control

. . . for high speed applications; 8-page *Bulletin* 470 covers a typical system, dividing it into its four components, each part of which is represented in the manufacturer's product line; including specifications and diagrams. Foxboro Co., Foxboro, Mass.

Circle No. **56** *on Reply Card*

Did You Miss These?

The following items, reviewed originally in October, have aroused considerable interest among the readers. They are repeated briefly as a service to those who might have missed them the first time they appeared. For details or literature, please use the regular Reply Card in this issue.

Needle and Globe Valves are Added to Line of Plastic Pipe

Made of an unplasticized polyvinylchloride, a wide selection of needle and globe valves have been made available for use with the "Boltaron" line of plastic pipe and fittings. They are furnished in standard IPS sizes of ⅛, ¼, ⅜, ½, ¾, 1, 1¼, 1½, and 2 in. The material, Boltaron 6200, is said to have high chemical resistance to organic and inorganic acids, alkalies and alcohols. H. N. Hartwell and Son, Inc., Boston, Mass.

Circle No. **57** *on Reply Card*

Special Insert Permits Joint of Plastic Tubing & Metal Fittings

. . . in a matter of seconds. The new "Swagelok" Insert is placed in the end of the tubing, a finger-tight Swagelok Tube Fitting is placed over the end and the nut is tightened with an ordinary wrench. The new inserts, available in any metal, protect the tube fittings against cold flow in the plastic. They support the inside dimension of the plastic tubing while the torque-free fitting grips and seals

the outside dimension. Resistance to chemical action and oxidation, non-contaminability, visibility and extreme flexibility of Tygon plastic tubing—when used in conjunction with the new inserts and fittings—make the combination useful in the laboratory. Ordinarily the more rigid plastic tubings do not require an insert. Crawford Fitting Co., 884 East 140th St., Cleveland 10, Ohio.

Circle No. **58** *on Reply Card*

"Automatic" Factories

. . . considered as a coming reality by the president of an instrument company; excerpts from a recent talk by Henry F. Deever on how close we are to completely automatic manufacturing, and what it's going to mean to the American economy; in 16-page booklet. Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.

Circle No. **59** *on Reply Card*

Power Generation

. . . and distribution in the petroleum and chemical industries; 12-page *Technical Article GER-764*, by W. B. Wilson of the G-E Industrial Power Division, General Electric Co., Schenectady 5, N. Y.

Circle No. **60** *on Reply Card*

Steam Turbines

. . . for centrifugal compressors and blower drives; 18-page *Bulletin 1966-536-BP* shows engineering features, including four types of governing arrangements, hand and automatic nozzle controls and other accessories. Worthington Corp., Harrison, N. J.

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For Your Convenience

Business reply cards are included in each issue of Petroleum Processing to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing the first page of this section. Just circle the numbers corresponding to the numbers at the end of each item. Then fill in the rest of the card and drop it in the mail. No postage is required.

For Temperature Control

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Again demonstrating their remarkable effectiveness as a low-cost temperature control, a large processor reports Nicholson expansion steam traps, at about $35 each, are being installed on outdoor tanks and stills in place of temperature controls. These were costing $110.00 to $200.00, with cost of trap added.

The Nicholson traps are readily adjusted to pass condensate at any temperature below 212°F. No air binding. Lengths, 9" to 40". Easily installed, usually without supports. Pressure, 0 to 250 lbs.

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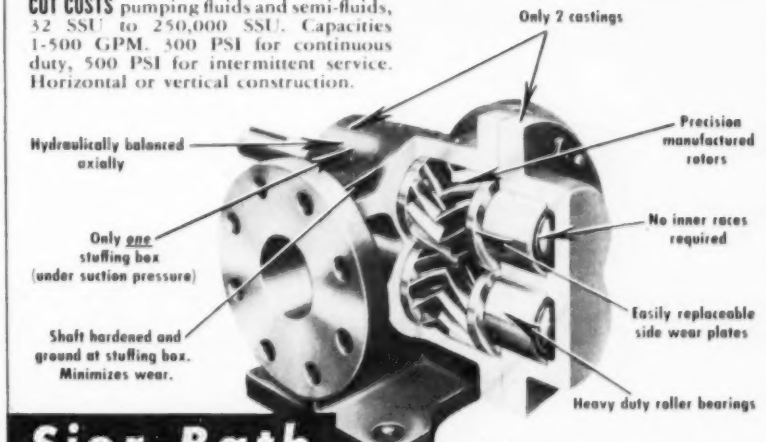
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EDITORIALS . . .

Brake on Petroleum Imports

THAT perennial political issue, legislation to restrict the volume of crude and residual fuel oil imports to a fixed ratio of domestic production, will be heard from shortly after Congress convenes in January. Its proponents may have new supporters within the oil industry in view of the substantial reductions in crude oil allowables which various state conservation agencies have imposed the past few months.

Consideration of all factors except the conditions of the immediate present should convince Congress that arbitrary restrictions of imports would injure both the oil companies and fuel oil users generally.

Conditions both in this country and abroad require that the relationship of imports to our own production be flexible and in the hands of the oil industry. Imported oil is chiefly that produced by American oil companies abroad. Sharp restrictions might have repercussions both economic and political in the countries where it is produced, and affect adversely our foreign trade.

The current high level of imports is only part of a general world over-supply of production which has been going on for months. The conservation agencies in Texas and other southwestern states belatedly recognized the situation as far as domestic production is concerned by reducing their allowable outputs. They have put on the brakes.

Importing companies can be depended on to use good judgment in setting the volume of crude and fuel oil they bring into the country. Keeping the brakes on both domestic production and imports for a few months will do much to restore balance in supply-demand and take off some of the pressure for legislation restricting imports.

—V.B.G.

Have You Organized Yet?

AN important first step toward reduction of corrosion losses in refineries has been taken. Data on the dollar cost resulting from metals deterioration in plants has been brought to the attention of the oil companies.

A quarter of a billion dollars annually is the preliminary estimate of just the *direct* costs of corrosion, as worked out by an API technical committee and made public at the annual society meeting in Chicago last month. This is even higher than the loss figure of $220,000,000 per year, arrived at by PETROLEUM PROCESSING in its own study and presented in the November issue.

Discount either estimate by any reasonable factor and the cost to the refiner for corrosion still stands at a tremendous figure. A saving of even 25% of this cost would represent a very substantial item in the operating budget of the refining companies. A program aimed at securing relief from the high corrosion costs by methods now known to be practicable will soon be presented to the industry through the API Division of Refining.

This program is the result of several years of study by a subcommittee of the Refining Division's Committee on Refinery Equipment. Its success in achieving savings will require the cooperation and participation of the entire refining industry.

Corrosion is a common problem. Every refiner experiences it even if he is among the few who now still believe they have no plant maintenance problems from the deterioration of materials. Present methods of attack on specific problems are obtained chiefly through the interchange of information on experiences of various plants in meeting similar problems. Therefore, the greater the number of contributions of experience data by individual companies, the greater the amount of this practical information which will be available to individual refiners.

The program will call for establishing corrosion protection groups in plants where they do not now exist. Duties and responsibilities of such groups will have to be well-defined and spelled out. Men new in this work will have to be trained. The importance of the work of the corrosion engineers will have to be emphasized by management. Means will have to be developed for coordinating work in different plants and different companies as well as that done by outside technical associations.

The stakes are high. Potential savings to the individual processing plants possible through an organized program are of such magnitude that corrosion protection work should have the full endorsement and active support of all refining companies.

—V. B. G.

People Are Still Important

THE structures and vessels and piping and buildings that are the Tuscola plant of National Petro-Chemicals Corp. are beautiful. They're new, well laid out, integrated and complete. But they're inanimate. It still takes people to put them together and to make the results operate.

When the new plant was dedicated last month the principal speaker, U. S. Senator Everett M. Dirksen of Illinois, made that theme the subject of his address. As he pointed out, all the things that make the plant—clay, iron, copper, and the like—have been sitting around since the time of Genesis. They'd still be sitting there if it weren't for people. Senator Dirksen dedicated the plant to the scientists and engineers who put their minds to work and figured out what to do with these inanimate materials.

We think the Senator has a good point. All too frequently we point with pride to our big new plants—and forget the individual people who made them possible.

—W. F. B.

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"Genetron" 150	$CH_2{=}CF_2$
"Genetron" 170	$CCl_2{=}CF_2$
"Genetron" 265	$CClF{=}CF_2$
"Genetron" 226	CCl_2F-$CClF_2$
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For example, several "Genetrons" have present and potential uses as monomers for fluorine-containing polymers: one points the way to a synthetic rubber which remains elastic at sub-zero temperatures, another to industrial plastics capable of withstanding the severest abuse. Still others make possible improved hydraulic brake fluids and superior coatings for electric wire. Some are also being utilized for vital military and scientific purposes, including atomic research.

As finished products, "Genetrons"—such as "Genetron" 12 and "Genetron" 11—are important as basic refrigerants for all types of household, commercial and industrial refrigeration and air conditioning equipment. These and other "Genetrons" are also the dispersants that make possible the vast array of aerosols and pressure-propelled products on today's market.

For these—and countless other thought-provoking applications—"Genetrons" open the way to building new and better products for many producers. Why not investigate their possibilities in *your* program, too?

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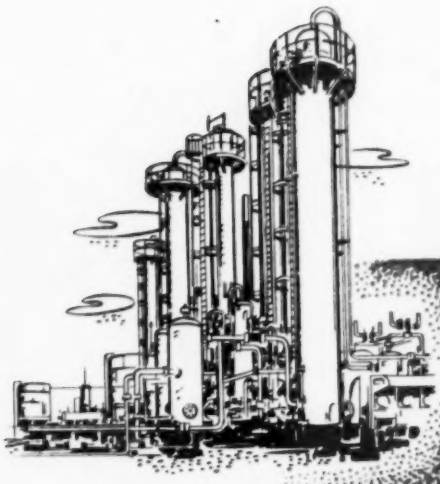

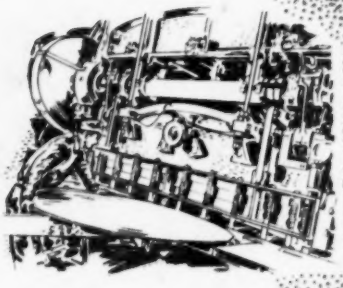

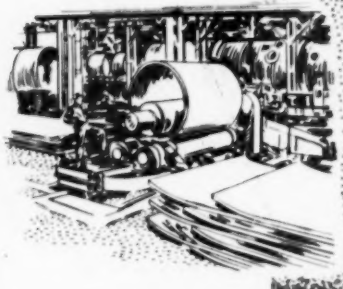

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